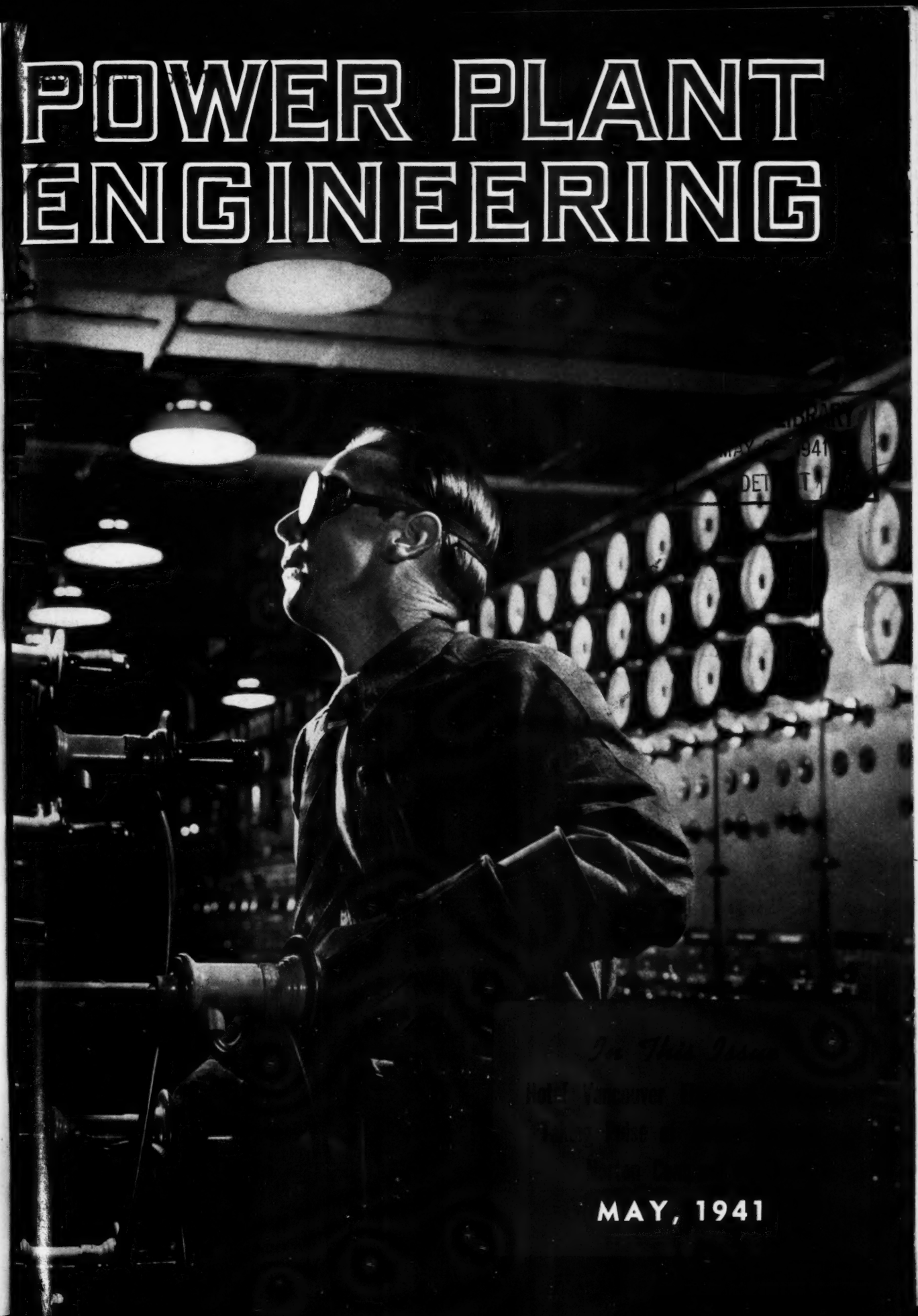
POWER PLANT ENGINEERING



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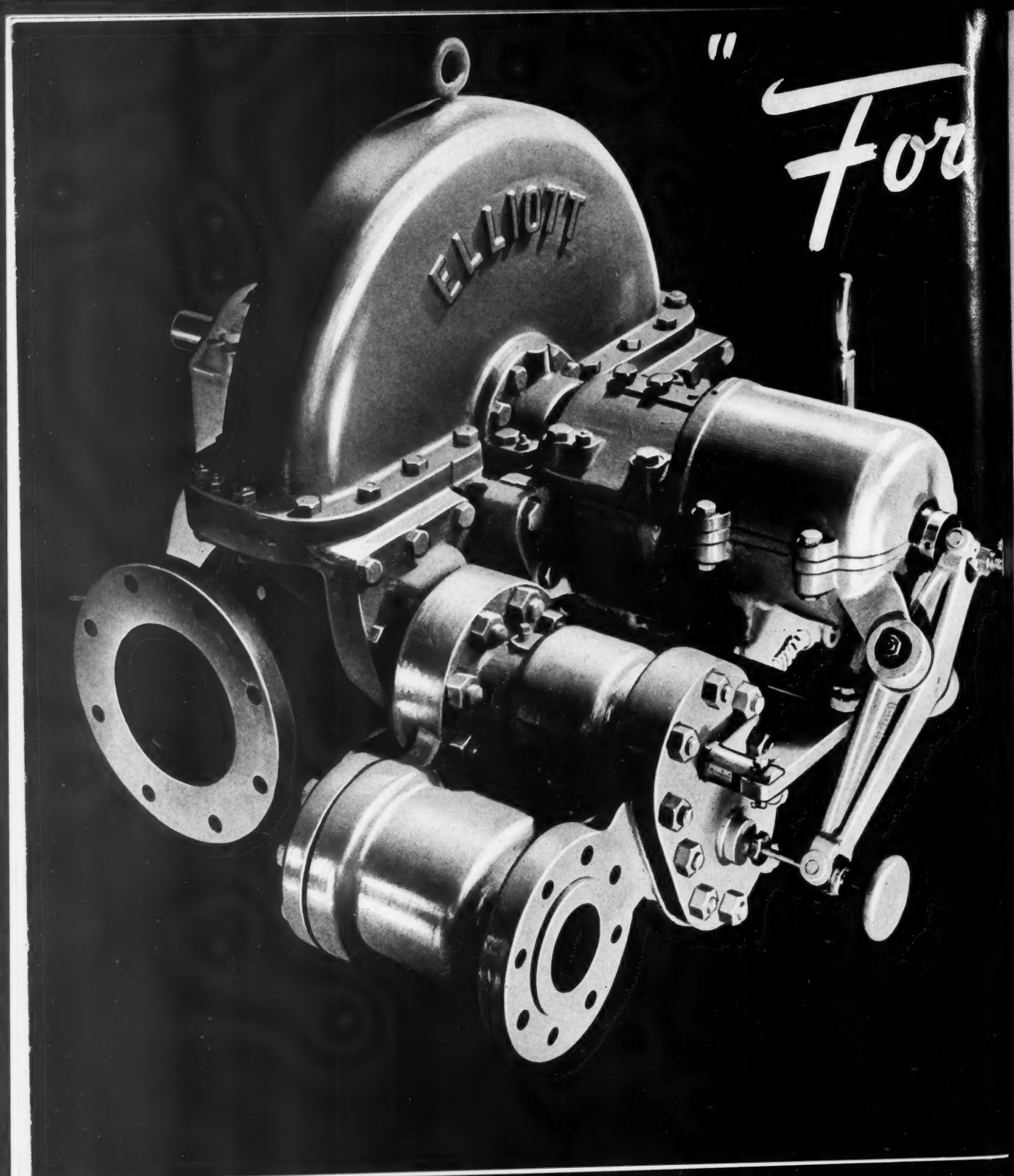

ELLIOTT

POWER PLANT ENGINEERING

MAY, 1941

VOLUME 45, No. 5

Cover: Substation operator testing circuits for street lighting service. Photo by Duquesne Light Company.

The Voice of Industry. By C. Donald Dallas 45
Watersphere 46
With the Editors 47
The Norton Company Plant at Worcester. By Francis J. Sill 48
Superheating and Desuperheating Between Line and Receiver. By F. W. Hutchinson 54
Taking the Pulse of Turbine Buckets 56
Features of Diesel Engines with Opposed Pistons 58
Sodium Pentachlorphenate Treatment for Cooling Water. By Max Gelfand 60
Candle Power, Lumens, Foot Candles. By John Q. Wendell 62
Gas Explosion Pressures. By Merl D. Creech 63
Electrical Features of the Hotel Vancouver. By Frederick H. Fullerton 64
Steam Turbine Lubrication. By C. Dantsizen 67
Beware Ammonia Hazards 69
Rapid Freezing—Without Excessively Low Temperatures. By R. L. Perry 70
What Does an Oil Do? By Earl Cooper 72
Refrigerating Engineer. By George Holman 73
A Letter from the Secretary of the Navy 75
Outside Boilers 76
Reset Controller for Sump Pumps 79
Midwest Power Conference 81
Paint Increases Heat Transmission. By Dr. Myron A. Coler 83
Practical Engineer and Electrician 85
Metering Saves Hotels Money. By Charles W. Parsons 102
New Equipment 104
Manufacturers' Personals 114
Manufacturers' News 126
News from the Field 128
Industrial Power Equipment 136
Smash the Atom 142
Training Mechanics 142
Defense Training 144
Speed of Electrons 146
Weighing a Magic Carpet 146
Human Engineering 148
Iron Alloy for Hearths 150
Severe Pump Service 150
Obituaries 152
New Engineering Books 154
Power Plant Construction News 156

Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

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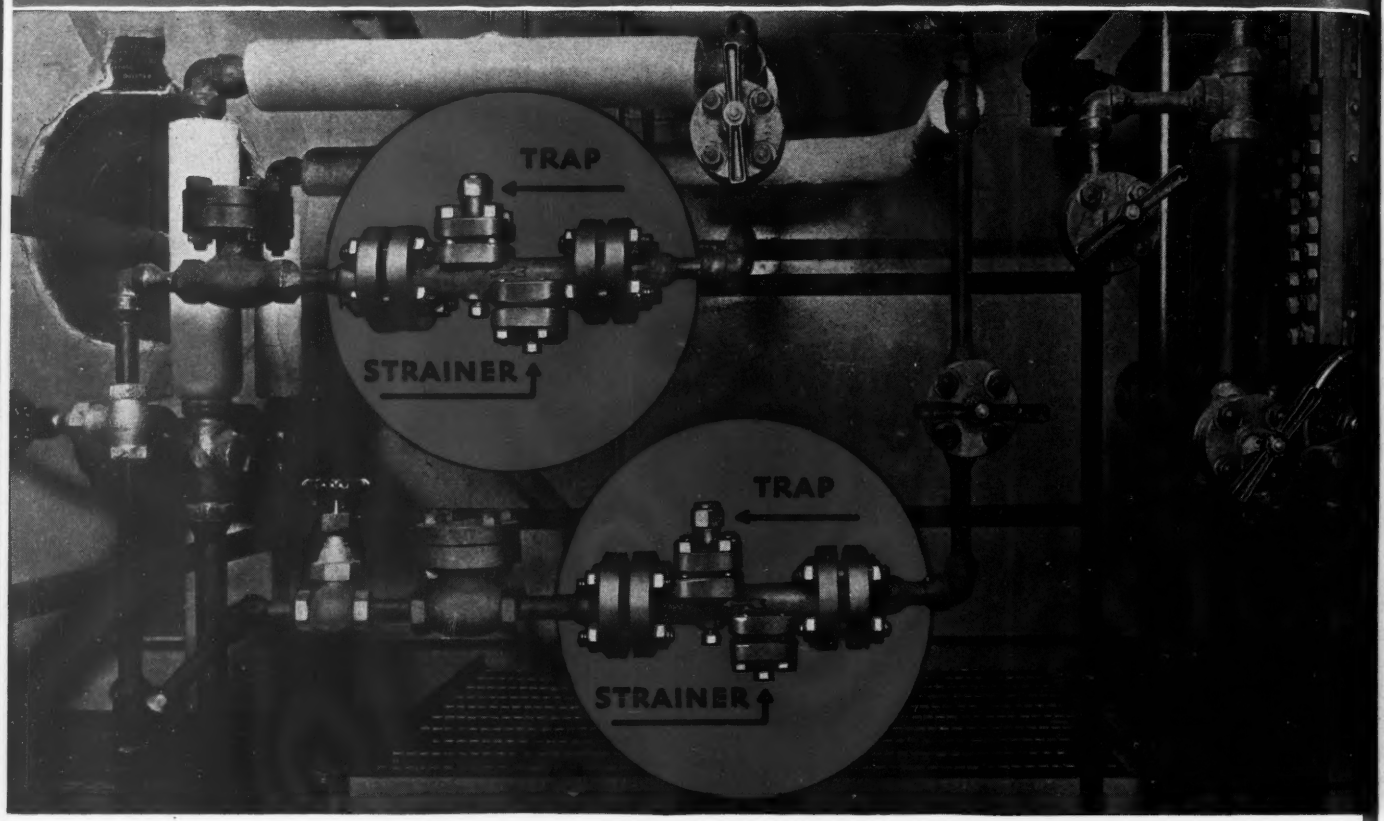
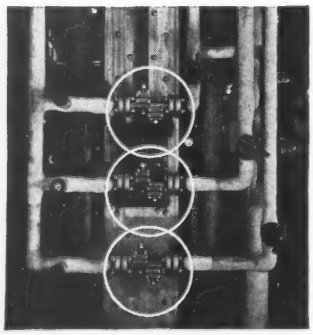
YARWAY "SUPER PRESSURE" TRAPS at Detroit Edison Company



Above: Yarway Impulse Steam Traps on superheater drip lines at Delray Station of Detroit Edison Company.

Yarway Impulse Traps and Integral Strainers Used at Conners Creek and Delray Stations



Above: Three Yarway Impulse Steam Traps on emergency stop valve, boiler-feed-pump turbine, and 200 lb saturated steam line at Delray.

After exhaustive tests and careful research, Detroit Edison has put Yarway Impulse Steam Traps to work draining emergency stop valves, superheater drip lines and main steam manifolds.

The Yarway Impulse Traps offered for such service were designed for pressures up to 1500 lb and temperatures up to 920° F. They are a special development embodying the same operating principle as the popular Yarway Trap found almost everywhere.

Of steel construction with integral strainers, they are supplied with flanged or welding ends.

Cannot Lose Prime on High Pressure, High Temperature Systems

Like lower pressure Yarway Traps, these traps offer the same advantages such as quicker draining and greater sustained efficiency—small size, saving space—light weight, requiring no support—straight through piping, simplifying installation—only one moving part and rugged construction, cutting maintenance cost. Then, too, there is no need to change valve or seat for widely varying pressures.

And when you consider that their average cost is usually no more than the cost of repairing an ordinary trap—why not get Yarway performance for your money? More than 90,000 have been installed.

A nearby Mill Supply Dealer handles Yarway Impulse Traps. Or write for Catalog T-1735.

YARNALL-WARING COMPANY
114 Mermaid Ave. Philadelphia

YARWAY IMPULSE STEAM TRAP

THE VOICE OF INDUSTRY

C. DONALD DALLAS on EMPLOYEES, DEFENSE PRODUCTION AND PROFITS

JUDGED by normal standards, 1940 was a successful year. But the year itself was not normal. We all know that a goodly share of our business came because of war—war that is reaching out to every corner of the globe.

As I write these words, there is a grave problem of security for many millions of people in Europe. Their problem is far removed from the everyday ones of finding work or earning wages, or making profits. It is much more fundamental. It is a question of preserving some semblance of personal security. Here in America we, too, must carefully guard our freedom.

The great National Defense Program is under way. Its success or failure may be the answer to our free way of living. National defense is national insurance. If America is to maintain its standard of living, it must produce all that is necessary with the greatest speed. Every American must give both loyalty and complete co-operation to his government. In the coming period, we must above all else co-operate with each other and work towards the same objective.

I am sure that all of us agree that our first obligation is to do all we can and even more, if possible, for our own country in its efforts in building national defense, and for England in its great fight to save civilization. Nothing must be permitted to interfere with these efforts.

Next we have an obligation or responsibility to the customers who have been doing business with us for years and who have made it possible for us to run our plants and to give employment to thousands of people. They have been the backbone of our production and employment and if there is any possible way to continue to serve them we will do so.

Today our problem is not to sell goods but to produce them. With defense requirements increasing daily, with large demands from normal channels, and with the difficulty of securing raw materials, we are hard pressed to supply the demand. When this condition exists, the question of profiteering enters people's minds. They remember the last great war when prices went sky-high and profits soared.

Today the situation is quite different. Despite the fact that there is an unprecedented demand for our products, soaring taxes and higher wages—prices have not gone up. This means there has been no profiteering. Profits have been possible through increased efficiency and increased production.

In the latter part of 1940, Revere felt definitely that shortages in vital raw materials such as copper and zinc were imminent. In releases to the press these facts were brought to the attention of the governmental agencies and the public. These shortages are still a definite threat. We mention this only because sufficient raw materials play an important part in keeping our employees at work and giving them the maximum hours of employment and are vital to Revere's defense production.

I wish that I were Prophet enough to tell what the future holds for all of us. We know that someday this emergency will be over. When we come out of it there will be facilities for producing goods far in excess of the nation's ability to consume—there will be competition between materials, products and services, such as we have never before witnessed or experienced.

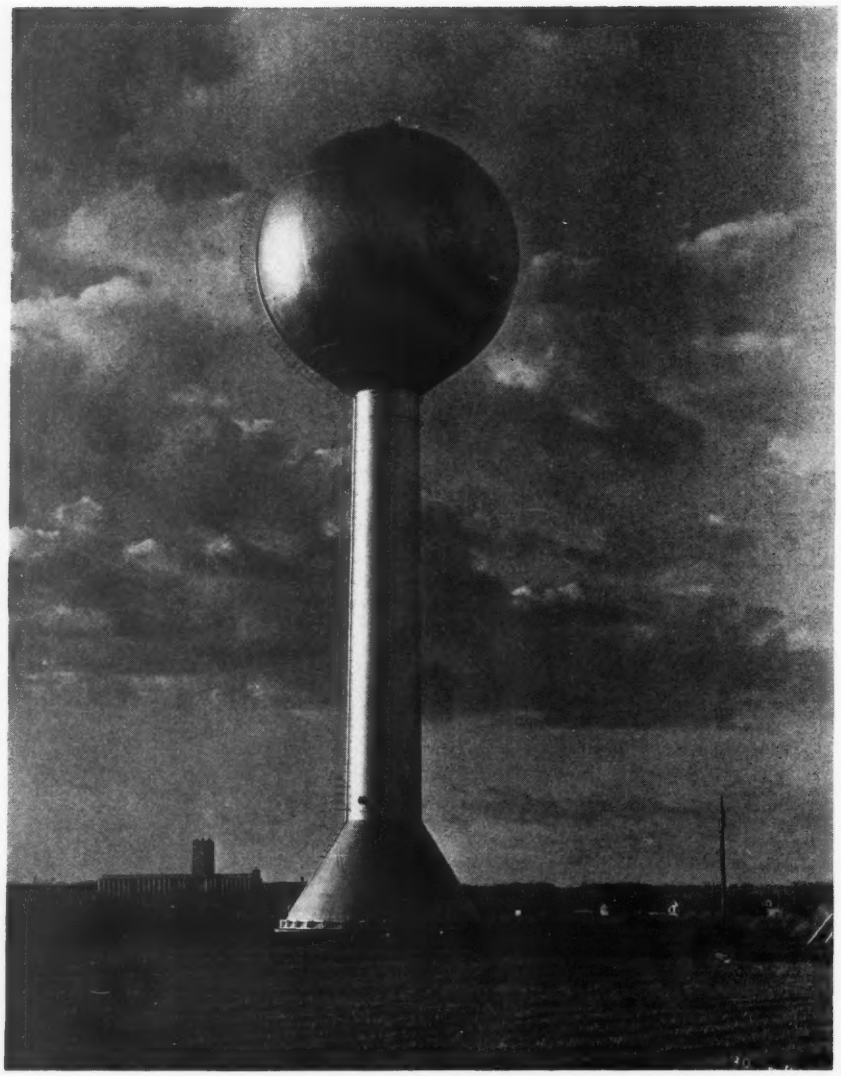
In order that Revere may keep its place in the industry we are continuing with our research work to develop new products that may provide additional outlets for our production facilities; we are going ahead with sales promotion and development plans; we are continuing our advertising to the public and to industry.

In 1940 we employed more people than ever before in our history. Hourly wages were at their highest level. The number of hours per week of work was increased. This in turn meant larger weekly pay envelopes. We produced and sold more of our products than ever before, and when we were all through we made a profit. At the same time, despite the rising costs of doing business, our customers have been receiving our products at reasonable prices. When such a balance exists, the interests of the employees, the owners and the general public are all served with justice. That is the true test of the American system.

C. DONALD DALLAS, president of Revere Copper & Brass, Inc., was born in Canada, received his education in Chicago and has had a wide industrial experience extending over some 40 yr. He and his father organized the Dallas Brass & Copper Co. in 1908 and as president in 1928 merged with five other companies to form the Republic Brass Co. of which he became first vice-president.

The name was changed in 1929 to Revere Copper & Brass, Inc., as a tribute to Paul Revere, America's first roller of copper. The earlier merger had brought Revere's original plant as well as a great-grandson, E. H. R. Revere, into the organization. Mr. Dallas became president of the Revere organization in 1931 and under his direction it has become an outstanding example of employer-employee relations predicated on the assumption that the success of each depends upon the other and both should share in the benefits. These remarks are part of a special report prepared by Mr. Dallas for Revere employees.

It is printed here because of the clarity with which Mr. Dallas has set forth the need for and practical test of the American system by which "the interests of employees, the owners and the general public are all served with justice."



Photo, Chicago Bridge and Iron Co.

WATERSPHERE

NOTHING escapes the moulding hand of the streamliner these days. First automobiles and trains, then razors, typewriters, bathtubs, telephones, toothbrushes, one by one, each in its turn, but inexorably, have fallen under his influence and had their posteriors altered to suit the time. So far, the fruit growers have been content merely to interfere with the coloring of their products, but probably before long they will apply streamlining to such commodities as pineapples and bananas. Imagine how much easier it would be to eat a streamlined banana. Only the day before Easter we experienced a severe nervous shock when we encountered a show window full of pink, green and purple baby chicks. For a moment we feared an attack of D T's, but the chicks were real—the color was added. When such things happen, it is therefore not surprising that the outdoor water tank has been streamlined—and renamed. Now it is called a watersphere. The one shown above, installed at Shakopee, Minnesota, by the Chicago Bridge and Iron Company, is typical of many tanks of this type that have been erected in recent years. This 250,000 gal. watersphere serves the town's population of 2464.

WITH THE EDITORS

◆ **DOLLARS . . .** Every man jack of us has a vital interest in economics, the dollars he receives, what they will buy and what becomes of his wages. Our wives know that prices are rising; all of us know that taxes are increasing so that dollars available for expenses are fewer. How far will these tendencies go? How will they affect our personal finances?

If the cost of materials, labor cost, or taxes increase, prices go up and a dollar buys less. But rise in prices will also depend on the active funds available to purchasers, who are the people, and these active funds are made up of money in banks, cash drawers and pockets, and of the deposits in commercial banks. Such active funds are now about $9,000,000,000 in money and $50,000,000,000 in commercial bank deposits. If active funds are increased, more are available to cause bidding up of prices when production of consumer goods decreases. This increase in active funds constitutes inflation.

In their joint report to Congress in December 1940, the leaders of the Federal Reserve System called attention to inflation possibilities and made suggestions as to remedies. For short term, these were briefly:

◆ **DO THIS . . .** 1. Borrow money from individual investors and institutions to pay for any gold bought and do not issue gold certificates, thus "sterilizing gold" as a source of inflating bank credits.

2. Let the devaluing power of the President for gold lapse.

3. Prohibit the issue of silver certificates as against profit from silver bought.

4. Repeal the $3,000,000,000 greenback authorization law of 1933.

5. Increase the legal reserve requirements for commercial banks, if necessary until the present excess reserves are wiped out.

6. Sell government bonds to individuals and to other investors.

◆ **OR ELSE . . .** Unless these things are done, or there is a very great and improbable increase in the production of consumer goods, inflation and price rise are likely to reduce greatly the buying power of the dollars received from insurance, savings deposits and wages.

Reasons behind these recommendations are as follows:

*Since 1923 active funds have nearly doubled, but a large part of the bank deposit funds have remained inactive because returns from business have made it unprofitable to put them to use; therefore, the yearly turnover in use of funds has, until recently, been decreasing, from 50 percent in 1929 to 14.3 percent in 1940. Turnover of such funds is now increasing due to large spending on defense, and prices are rising.

Government spending is calling for more taxes, which reduces the amount you have to buy clothes, food, rent and comforts.

Defense training reduces the labor available to produce goods. Government defense requirements take precedence, so that output of consumer goods is likely to be curtailed, resulting in decreased supply and increase of the turnover of active funds due to increased employment, or any inflation will augment rise in prices.

Inflation of active funds may come from: increase of bank credit due to government purchase of gold; further devaluation of gold; printing of greenbacks which have as a basis only government credit; issue of silver certificates against profit on silver bought.

For each ounce of gold bought by the treasury, the Federal Reserve Bank receives a gold certificate for $35 which adds to active funds and to bank credit inflation.

This bank credit inflation works as follows: For $10,000 deposited, a bank can lend $7500, on the basis of a cash reserve of 15 percent of deposits. This loan, if deposited by the borrower, becomes the basis for another loan of $6375 and so on, until a deposit of $10,000 can become the basis for $66,000 of bank credit. Excess of present deposits in banks above reserve requirements is now some $7,000,000,000, which can become the basis for an expansion of $46,200,000,000. Increase of reserve requirements will cut down this possibility of inflation.

The President has power to devalue government gold, now some $22,000,000,000, by 9 points, increasing active funds by $4,000,000,000. This power lapses on June 30, 1941, unless renewed by Congress.

Silver certificates can be issued for $1,500,000,000 against the government's profit on purchase of silver.

Total possible increase in active funds is $54,700,000,000, almost doubling present active funds.

What is the likelihood of such inflation?

◆ **TEMPTATION . . .** One great temptation lies in the government monopoly ownership of gold. In the present $22,000,000,000 hoard of gold, there is a present danger that government may further devalue its gold to reduce its debt, simply by depositing gold certificates in Federal Reserve Banks and issuing checks to bond owners. This is in effect repudiation.

Government monopoly of gold seems no longer to serve any purpose of protecting farmers or manufacturers against international competition, and restoration of gold to circulation in a normal way would remove the temptation, to repudiate government obligations by further devaluation of gold.

Threat of inflation by some means will be present so long as government debt continues its 10 yr. trend to ever greater and faster increase.

Government borrowing by selling bonds to banks has been $11,000,000,000 since 1931. New borrowing by the government will be some $15,000,000,000 during the next 15 months, with more to follow. While all bonds possible will be placed with insurance companies and individual investors, the banks, to protect their holdings, must support the government credit by buying bonds as long as they can. But continued and indefinite increase in government borrowing must result in danger to government credit.

To stop debt increase requires reduction of unnecessary spending, and increase of revenue by higher taxation.

◆ **OUR JOB . . .** What is our job under these conditions—for each of us?

Trying to hedge against the results of inflation is well nigh impossible for the average man, who has neither capital reserves nor investment facilities to do it effectively. Purchase of lasting goods such as houses, clothing, furniture will help a little, but most of the losses in the buying power of savings bank deposits, life insurance, annuities, pensions, wages will fall on the small-income man.

The best hedge is for everybody to co-operate in helping to avert inflation, and the means recommended in the joint report are:

1. Each according to his ability to buy government bonds and hold them in order to reduce bank credit inflation.
2. Work for repeal of the 1933 law for government monopoly on gold, so as to restore gold money to circulation and check devaluation.
3. Work for legislation recommended by the joint report: i.e., to stop the issue of silver certificates against profits on silver; to repeal the greenback authorization law of 1933; to increase the legal reserve requirement on bank deposits.
4. Insist on the reduction of non-defense expenditures.
5. Stop requests for spending by the Federal Government on local improvements.
6. Accept the need for higher federal taxes, which should be designed solely to produce revenue.

Getting on a pay as you go basis as quickly as possible is essential. Trying to push debts over onto the future increases the likelihood of large inflation and, if that comes, we shall all be likely to pay by the greatest possible disaster—break down of government credit.

***An article by Harry Sherman, "Will We Have Inflation?" in The Saturday Evening Post of April 12th, 1941 gives much of the data here presented.**

The

Fig. 1. An aerial view of the great plant of the Norton Company at Worcester

ON THE OUTSKIRTS of the city of Worcester, Massachusetts, there stands a great industrial plant which in many ways forms the basis of our entire industrial life. This is the plant of the Norton Company, one of the largest firms in the world devoted to the manufacture of abrasives and abrasive machinery.

If, as has been so frequently pointed out lately in connection with defense activities, the machine tool industry forms the bulwark of our entire industrial productive system, it may be said with equal truth that the abrasive industry lies at the base of the machine tool industry. Without abrasives, without the precision grinding equipment incorporated in modern machine tools, the mass production of automobiles, electrical machinery, tractors and agricultural machinery would be quite impossible. Not as spectacular in the appeal of its products as some of our other great industries, the abrasive industry is nevertheless just as vital and its growth during the past 50 yr. is adequate testimony to its importance. From simple beginnings in the use of natural sandstones it has developed a variety of complex synthetic abrasives, many of which can be produced only in great electric furnaces. Today the raw materials used in the manufacture of abrasives come from the far corners of the earth—bauxite from Arkansas, borax from Death Valley, diamonds from South Africa, clays and feldspars from various places, shellac from India, latex from Malaya. All these and many other materials form the raw material from which modern abrasives are produced.

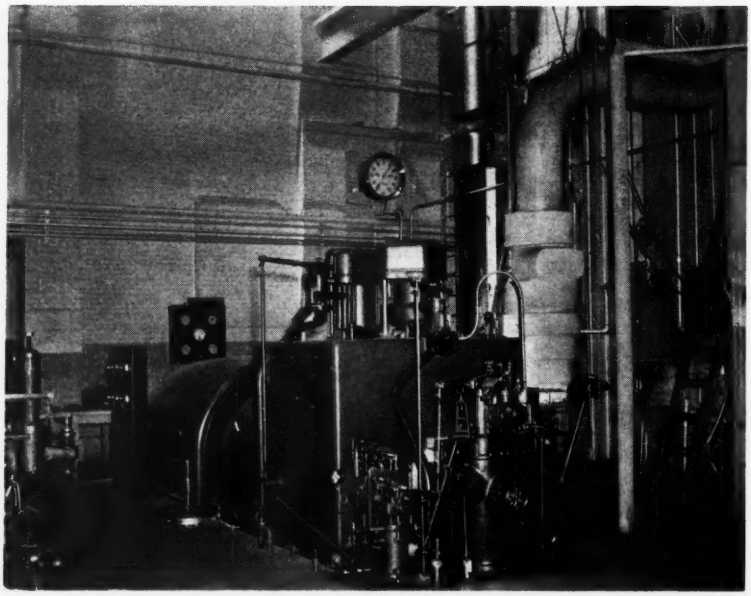


Fig. 2. The new 2500 kw. extraction type turbine-generator

In their never-ending search for new and better materials, the engineers of the Norton Company have figuratively combed the earth's surface and tested the products of all the continents. The growth of the great American industries, the automotive, the steel industry, the railroads and the communication field, etc., provided the incentive for research and continued scientific development in the production and use of abrasives.

Starting from a small beginning in 1885 with the incorporation of the Norton Emery Wheel Company and a small shop, the company developed continually. Today the plant of the Norton Company at Worcester consists of more than 80 buildings containing approximately 2,250,000 sq. ft. of manufacturing floor space. A line run diagonally across this plant measures exactly 1 mi. as the crow flies.

Norton Company Plant At Worcester

The rehabilitation of the boiler plant at the plant of the Norton Company by the installation of modern high-pressure boilers and the extension of the facilities to include a limited amount of electric generation forms an excellent example of a program that is applicable to many other industrial plants served by obsolete steam plants.

By FRANCIS J. SILL
Consulting Engineer, Westboro, Mass.

The Norton plant at Worcester, however, is only one of many Norton plants erected in various parts of the world. To get a complete picture of the Norton Company activities one would have to visit the Norton plants in Paris, France; Wesseling, Germany; Welwyn Garden City, England; Corsica, Italy; Sidney, Australia; Chippawa, Ontario, Canada, and other places.

Interesting as the ramifications of this great industrial organization may be, it is the purpose of this article to describe a small but nevertheless very important element of the organization, i.e., the generation of steam and electric power for the plant at Worcester.

In the past nearly all of the electrical energy used at the Worcester plant was purchased from the local power company. For the production of steam for heating and process work, however, a boiler plant was maintained and this had installed in it a 500 kw. turbine-generator, operating at 150 lb. steam pressure. The exhaust steam from this unit was used for building heating.

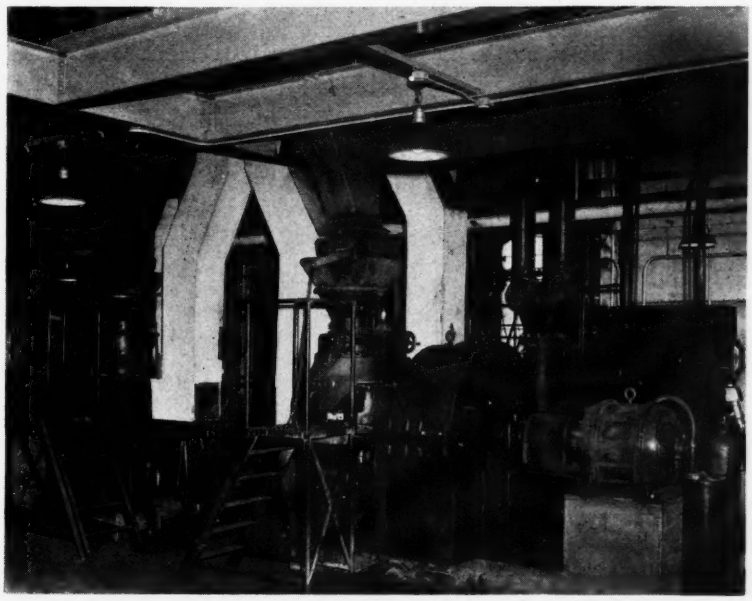


Fig. 3. The two pulverizing mills are installed on the operating floor

This plant had been in operation for a number of years and while the boilers, which were underfeed stoker water tube units operating at 125 lb. pressure, were still in serviceable condition, consideration was given several years ago to their replacement by newer and larger units to meet growing steam requirements.

Several studies were made and finally it was decided to install high-pressure boilers together with an automatic extraction, back pressure turbine-generator. A considerable amount of 125 lb. pressure steam was required for process work in the factory and such a turbine could supply this steam from the extraction stage, at the same time producing a considerable amount of electrical power. The turbine would not satisfy all of the electrical requirements, but its use would permit the employment of modern, efficient, high-pressure steam generating equipment and the electrical energy would be in the nature of a byproduct. It would materially decrease the amount of electric power that had to be purchased.

Accordingly, some 2 yr. ago plans were made to proceed with these changes. Inasmuch as the new equipment had to be installed in the existing boiler house without interfering with the normal production of steam, the work involved the need for considerable resourcefulness on the part of the engineers

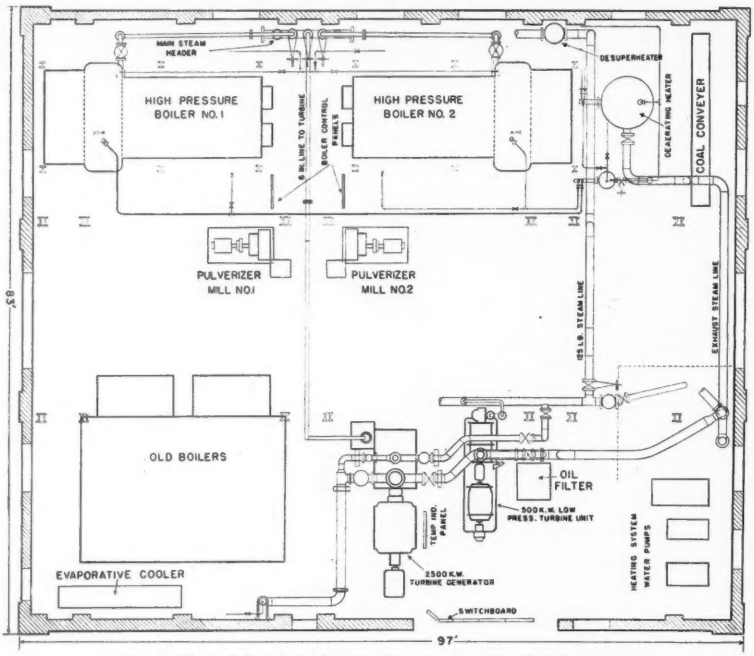


Fig. 4. Plan of the plant showing the arrangement of equipment

doing the work. An analysis of load conditions showed that the immediate steam requirements would be satisfied by the use of two steam generating units with a maximum capacity of 50,000 lb. of steam per hr. each. The size of the turbine-generator was determined largely from a careful study of the process steam demand. A 2500 kw. unit was finally selected. As already indicated, process steam is required at pressures normally around 125 lb. and with the new arrangement this is obtained from the extraction stage of the turbine. Additional process steam, if needed, can be obtained from the high-pressure boilers through a reducing valve and a desuperheater.

The two new steam generators are Riley Stoker Corp. units, complete with self-contained water cooled furnaces, economizers, air heaters and superheaters. They are rated at 50,000 lb. of steam per hr. each and are designed for operation at 725 lb., 750 deg. F. They are completely steel clad and are fired by pulverized coal, each boiler having two burners. Although designed to operate at 725 lb. pressure, the operating pressure is 680 lb. since the turbine is designed for an initial steam pressure of 650 lb.

To provide space for the two new boilers and the associated equipment, four old boilers were removed. Since the old boilers were much smaller than the new ones, the problem involved in fitting the new equipment into the existing building was a difficult one. The units were set face to face because of the existing building steel columns.

The work was done so effectively, however, that practically no changes in the building structure were required. Even the roof remained untouched; some glass was taken out of the monitors to accommodate a few pieces of projecting equipment but other than that the building remained intact. Practically the entire existing coal-handling arrangement was retained with no changes.

An overhead steel bunker ran the full length of the boiler room. This was supplied by a distributing belt conveyor installed above and that in turn was fed by a bucket conveyor system at one end of the building. Before the rehabilitation, the coal was delivered from the overhead bunkers to a weigh larry and then to the stoker hoppers, since the boilers on both sides of the building faced a central firing aisle. .Now, the pulverizing mills are located in what formerly was the central firing aisle and a traveling weigh larry distributes coal to their hoppers. The installation of this coal larry was the only additional coal-handling equipment necessary to complete the new installation.

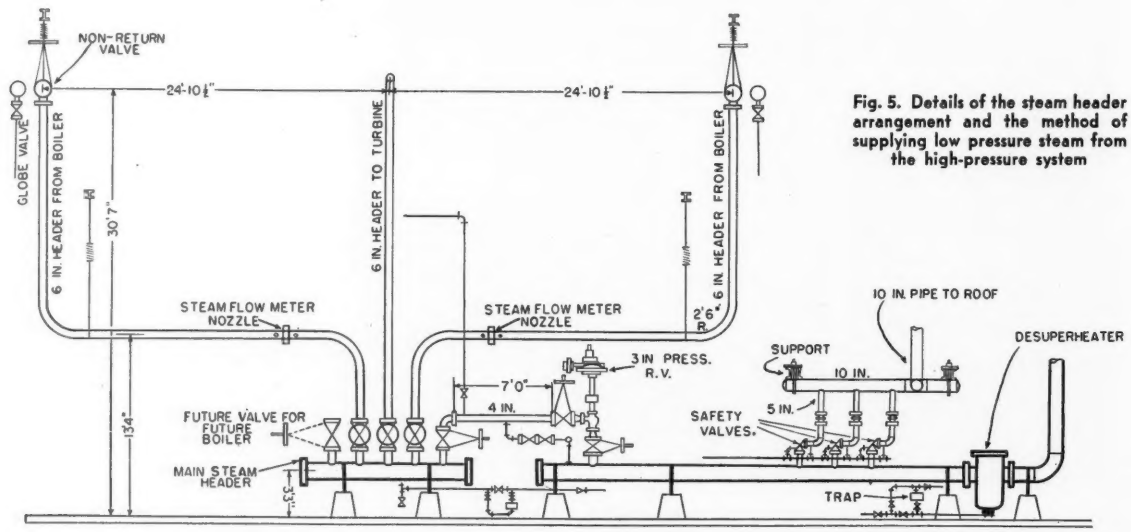


Fig. 5. Details of the steam header arrangement and the method of supplying low pressure steam from the high-pressure system

PRINCIPAL EQUIPMENT IN THE POWER PLANT OF THE NORTON COMPANY

General

LOCATION—Worcester, Massachusetts.
OWNER—Norton Company.
INDUSTRY—Grinding Wheels and Machines.
CONSULTING ENGINEER—Francis J. Sill, Westboro, Mass.

Boiler Equipment

BOILERS—2 steam generating units with water walls and superheaters; 7410 sq. ft. H.S. each; designed for 725 lb. w.p. 750 deg. F. total steam temperature. Maximum capacity—50,000 lb. gage. Operating pressure—680 lb. gage. Equipped with steel-clad furnace settings. Riley Stoker Corp.

ECONOMIZERS—2 forged steel headers and bare tube type; 1030 sq. ft. each. Riley Stoker Corp.

AIR HEATERS—2 tubular type; 3800 sq. ft. H.S. each. Riley Stoker Corp.

PULVERIZERS AND BURNERS—1 motor driven pulverizer and 2 burners per boiler. Riley Stoker Corp.

PULVERIZER MOTORS AND STARTERS—60 hp. Westinghouse Electric & Mfg. Co.

FORCED DRAFT FANS—1 per boiler with Vortex inlet. B. F. Sturtevant Co.

FORCED DRAFT FAN MOTORS AND STARTERS—25 hp. (2 speed) Westinghouse Elec. & Mfg. Co.

INDUCED DRAFT FANS—1 per boiler. B. F. Sturtevant Co.

INDUCED DRAFT FAN MOTORS AND STARTERS—60 hp. (2 speed) Westinghouse Elec. & Mfg. Co.

FLUE DUST COLLECTING SYSTEM—Controlled multicyclone, consisting of 18 cyclones. Prat-Daniel Corp.

BOILER FEED PUMPS—2, centrifugal type; 1 at 120,000 lb. per hr. at 1986 total head ft., 1 at 60,000 lb. per hr. at 1986 total head ft. Ingersoll-Rand Co.

BOILER FEED PUMP MOTORS AND STARTERS—1—200 hp., 1—125 hp. (constant speed)—Westinghouse E. & M. Co.

FEEDWATER HEATER—1 deaerating type; capacity 120,000 lb. per hr.; temperature of water leaving heater 220 deg. F. Worthington Pump & Machinery Corp.

COMBUSTION CONTROL — Automatic. Hagan Corp.

FEEDWATER REGULATORS—1 Copes 3 in. Flowmatic regulator valves for each boiler. Northern Equipment Co.

EXCESS PRESSURE FEEDWATER REGULATOR—1 Copes 4 in. differential pressure control valve for both boilers. Northern Equipment Co.

WATER COLUMNS—Reliance; equipped with Eye-hye remote reading water gages. Reliance Gauge Column Co.

SOOT BLOWERS—Diamond Power Specialty Co.

BLOW-OFF VALVES—Yarway. Yarnall-Waring Co.

SAFETY VALVES — Consolidated Ashcroft Hancock Co.

HIGH PRESSURE STEAM AND WATER VALVES—Gate Valves—Chapman Valve Co. Globe and Check Valves—Edward Valve & Mfg. Co.

BOILER INSTRUMENTS—Bailey Meter Co. 2—Steam flow-air flow meters—indicating, recording and integrating steam leaving each boiler. 2—Multi-pointer draft gages—indicating. 2—Temperature recorders—superheated steam, gas leaving air heaters and air leaving air heaters. 1—Fluid meter—recording and integrating the rate of flow of feedwater to both boilers.

FEEDWATER TREATMENT — Hall Laboratories.

Coal and Ash Handling

COAL LARRY—For weighing and supplying coal from overhead storage bunker to pulverizers. Beaumont Birch Co.

ASH HANDLING — Steam pneumatic system; capacity 10 t. per hr. Removes ashes, fly ash and soot from both boilers and from hoppers in flue dust collecting system. This equipment includes a tile ash storage tank with a motor-driven dustless unloader. United Conveyor Corp.

Turbine Equipment

TURBINE—1—2500 kw. turbine arranged for 125 lb. automatic extraction and 2 to 5 lb. back pressure operation, directly connected to an electric generator. Turbine speed 3600 r.p.m. Turbine designed for initial steam at 650 lb.—750 deg. F. General Electric Co.

GENERATOR—3125 kv-a., 4600 v., 3 phase, 60 cycle, 80 percent power factor, alternating current generator with 25 kw., 125 v. General Electric Co.

TURBINE LUBRICATING OIL FILTER—S. F. Bowser Co.

EVAPORATIVE WATER COOLER—Buffalo Forge Co.

ELECTRIC SWITCHBOARD—Metal clad. General Electric Co.

TURBINE CRANE—10 t., hand-operated. Shaw-Box Crane & Hoist Div.

EVAPORATIVE WATER COOLER PUMP—Buffalo Forge Co.

TURBINE METER—For recording and integrating steam to the 2500 kw. turbine unit. Bailey Meter Co.

Miscellaneous Pumps

FEEDWATER TREATING PUMP—Motor-operated duplex chain-driven. Worthington Pump & Machinery Corp.

STEAM CONDENSATE RETURN PUMP—Motor-operated centrifugal pump, 125 g.p.m., 35 lb. discharge pressure. Ingersoll-Rand Co.

Miscellaneous Equipment

FLASH TANK—Hagan Corp.

STEAM DESUPERHEATER — 80,000 lb. per hr. capacity. Elliott Co.

DESUPERHEATER CONTROL — Mason-Neilan Regulator Co.

PRESSURE REDUCING VALVE — Mason-Neilan Regulator Co.

RELIEF VALVES—To protect 2500 kw. turbine unit. Cochrane Steam Specialty Co. and Atwood & Morrill Co.

PRESSURE GAGES—Ashton Valve Co.

THERMOMETERS — Taylor Instrument Co. and Minneapolis-Honeywell Regulator Co.

PIPING—Jennison Co.

ELECTRICAL CABLES AND WIRING—Norton Company.

ELECTRIC TRANSFORMERS — Westinghouse Elec. & Mfg. Co. and Allis-Chalmers Mfg. Co.

PLATFORMS AND COAL HOPPERS—New England Structural Steel Co.

FLUE—Jennison Co.

BOILER BLOW-OFF TANK — Southbridge Roofing Co.

HEAT INSULATION — Rhode Island Covering Co.

The general arrangement of the equipment at present is shown in Fig. 4. The two new boilers are installed so that they face each other and the pulverizers are placed alongside. A boiler control panel occupies the space between the boilers and the pulverizers as shown.

Although this placement of the boilers was dictated by the necessity of fitting the units into the existing space, it forms a convenient and altogether very satisfactory operating arrangement. The two control panels face each other and the two pulverizers are close enough to the panels and the boilers themselves, to give a single operator complete supervision over all the equipment.

Another convenient and highly desirable feature of the installation is the location of the main steam header, together with all important control valves alongside the boilers on the operating floor level. In many boiler plants this header and these valves are up high where it takes time and effort for the operator to reach them. Here they are within easy reach of the operator on duty and in times of emergency this is an important asset.

The desuperheater is also located at this point. As shown in the accompanying sketch this is connected into a separate header fed through a reducing valve from the boiler header. The purpose of this desuperheater is to desuperheat steam for process work when the 2500 kw. turbine is not in operation. It is an Elliott Co. cartridge type unit with a capacity of 80,000 lb. per hr. and is provided with a Mason-Neilan temperature controller for automatically controlling the temperature of the steam leaving the desuperheater. To guard against danger due to possible excess pressure in the desuperheater and low pressure steam lines due to failure of the reducing valve or the improper opening of the bypass valve, the low pressure header feeding the desuperheater is provided with three relief valves of adequate capacity.

The main steam piping is simple and direct. As shown in Fig. 4 and 5, a 6-in. line from each boiler connects into the main steam header already referred to and a 6-in. line from this header runs straight up and across the room to the high-pressure turbine.

The low pressure piping is obvious from the drawing (Fig. 4). There are two systems: one, the 150 lb. system, connected to the extraction stage of the high-pressure turbine and from which the low presesure turbine (the 500 kw. unit) obtains its supply, and the 2 to 3 lb. exhaust system. Both turbines exhaust into this line.

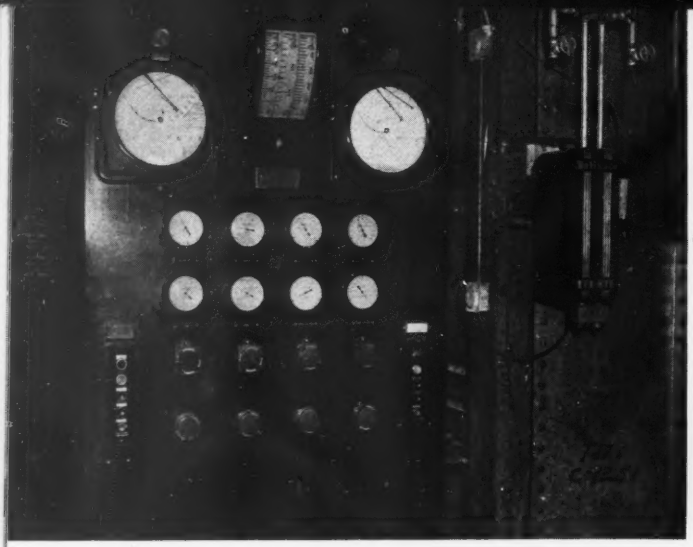


Fig. 6. One of the boiler control boards

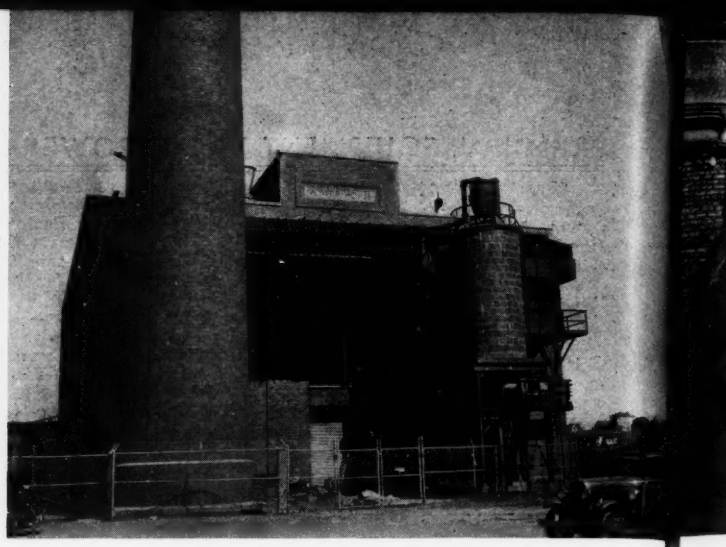


Fig. 7. An outdoor view showing the ash storage tank and the flue dust collecting system

This steam is used for building heating and also to heat the feedwater for the boilers.

The general arrangement of the two new boilers and the associated equipment is well shown by Fig. 8. This drawing shows the compact disposition of the various elements. There is very little room to spare, yet the installation is in no sense crowded. The location of the air heaters together with the forced and induced draft fans above the boilers makes a very convenient air-duct arrangement and provides a short and direct line of gas travel to the stack. Both forced and induced draft fans are motor driven and operate under automatic control from the Hagan Combustion Control System. The economizers which are of the forged-steel header bare-tube type are placed in the upper rear corner of the boiler directly between the gas outlet of the boiler and the gas inlet of the air heater; here again we have the utmost in the conservation of space.

From the induced draft fans the flue gas is discharged through a short length of horizontal breeching to a flue dust collecting system installed on the outside of the boiler house adjacent to the stack. The dust collecting system is a Prat-Daniel Corporation controlled multicyclone system consisting of 18 cyclones.

Each boiler is served by one pulverizer supplying two burners in each furnace. These are set in a horizontal, plane in the front wall of the furnace at a height of about 10 ft. above the operating floor. The boilers are completely steel clad.

Boiler accessories include Copes "Flowmatic" feedwater regulators, pressure feedwater regulator, Reliance water columns, Diamond soot blowers, Yarway blowoff valves and Consolidated safety valves. In addition to the regular soot blowers, two retractable soot blowers are provided on each unit. One of these takes care of the slag screen and the other the front edge

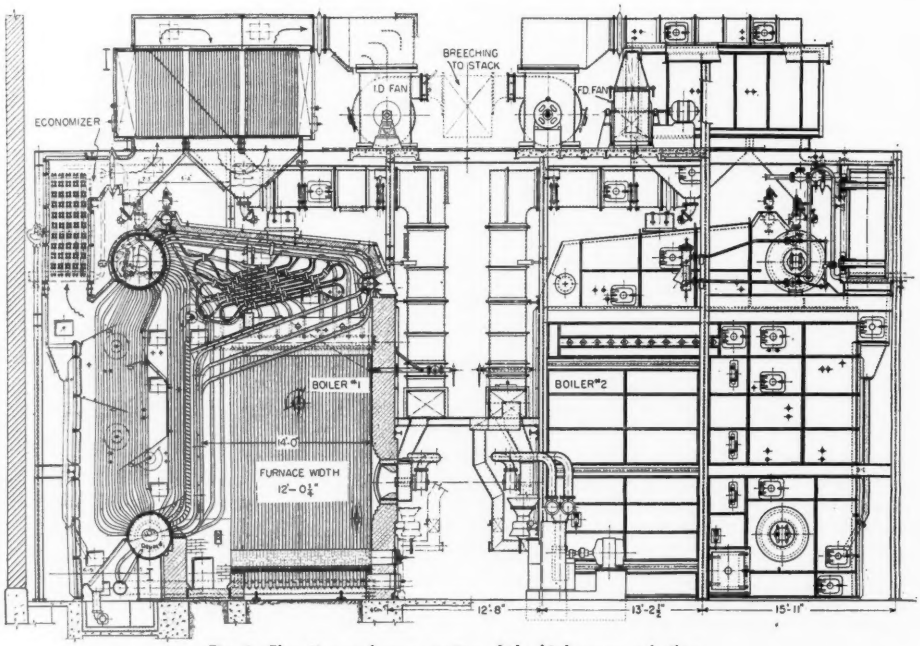


Fig. 8. Elevation and cross section of the high pressure boilers

Fig. 9. A view on the forced and induced draft fan floor

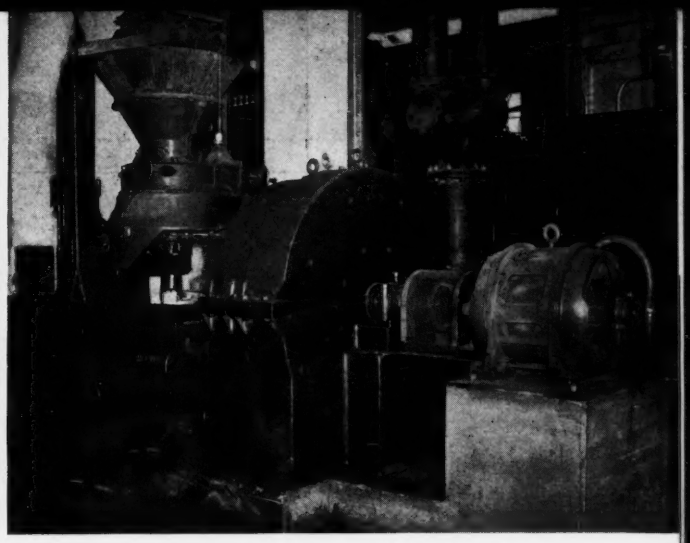


Fig. 10. A closeup of one of the pulverizers

of the baffle slag screen and superheater.

Boiler instruments consist of Bailey Meter Co. steam flow-air flow meters, Multipointer draft gages, temperature recorders and feedwater meters. The Reliance water columns are equipped with Eyehye remote reading water gages.

Ash is handled by a United Conveyor Corporation steam pneumatic system having a capacity of 10 tons per hr. This removes ashes, fly ash and soot from both boilers and from hoppers in the flue dust collecting system. It includes a tile ash-storage tank with a dustless unloader.

Boiler feedwater make-up is city water, treated by the Hagan System using phosphate and caustic. These chemicals are placed in a tank, filled once in 24 hr. in proportions determined by analysis. The compound is pumped into the boiler by a motor operated, duplex chain-driven plunger pump. The operation of this pump is of interest. It is controlled by a time switch which operates the pump for about 10 min. every hour. After the pump starts, it pumps compound for about 4 min.; then another time switch closes the compound valve, which is a three-way valve, and turns on water to flush the compound out of the pump and valve. The arrangement is simple, effective and completely automatic.

The feedwater is heated in a 120,000 lb. per hr. Worthington deaerating heater by exhaust steam from the turbines. The temperature of the water leaving the heater is around 220 deg. F. Two centrifugal feed pumps are installed, one with a capacity of 120,000 lb. per hr. at 1986 ft. head and the other 60,000 lb. per hr. at the same head. Both pumps are motor driven. All condensate returns and city water make-up are delivered to the feedwater heater.

Boiler-water concentration is controlled by a continuous blowdown system. The blowdown passes into a flash tank from which the water discharges to the blow-off tank and most of the flashed steam is sent to the feedwater heater.

The new turbine generator consists of a 2500 kw. turbine designed for 650 lb., 750 deg. F. initial steam and arranged for 125 lb. automatic extraction and for 2 to 5 lb. back pressure, direct connected to a 3125 kv-a. 4600 v. 3 phase, 60 cycle, 80 percent power factor alternating current generator with 25 kw., 125 v. direct connected exciter. Both generator and exciter are completely enclosed and supplied with recirculated air from a surface air cooler. The unit is, in fact, the first industrial plant generator of this kind. An interesting feature of the cooling system is the fact that an evaporative type of water cooler is installed for cooling the water for the surface air cooler and the lubricating oil cooler on the generator. This evaporative cooler is placed along the wall behind the two remaining old boilers. Its use has proved very satisfactory and operates with less than 1 percent make-up.

The old turbine generator, the 500 kw. unit, has been relocated alongside the new unit. It is arranged for an initial steam pressure of 125 to 150 lb. and like the large unit operates at from 2 to 5 lb. back pressure. This unit is operated during the winter months when more steam is demanded for process and building heating than is required to operate the 2500 kw. turbine at full load. Steam is then supplied from the 125 lb. extraction line to the 500 kw. turbine in order to generate maximum amounts of electric power as a by-product of steam required for the factory. This 500 kw. unit also is operated during periods when the 2500 kw. machine may be out of service.

Exhaust steam and also a certain amount of 125 lb. steam is used in winter for building heating. The factory is heated by hot water which is heated in four heaters installed in the boiler plant. Three of these heaters are low pressure heaters while the fourth is a high-pressure heater using 125 lb. extraction steam. The hot water is circulated through the heaters and the heating system by three pumps, two steam driven and one motor driven.

This, briefly, completes the description of the mechanical features of this plant. Electrically, the installation is quite simple. The 4600 v. generator feeds directly into the 4600 v. bus. The 460 v. machine, that is the 500 kw. unit, feeds a 460 v. distribution cabinet and is also tied into the 4600 v. bus through a 750 kv-a. transformer bank. From the 4600 v. bus, a 500,000 cm. cable carries power at this voltage to various distribution centers in the factory.

Control of the electrical circuits and the generators is centered on a new General Electric Co. switchboard near the turbines. A steel panel mounted at the side of the 2500 kw. generator carries temperature indicators showing the oil temperatures on the three bearings of the generating unit.

From an engineering standpoint the rehabilitation of this plant presents an excellent example of a program that is applicable to many other old industrial power plants.

(Continued on Page 59)

Superheating and Desuperheating Between Line and Receiver

With steam pressures and temperatures in use today, dangerous temperatures may result when steam flow is stopped suddenly; for instance, when it flows into a receiver. On the other hand, flow from a receiver results in a temperature drop which is often confused with line losses. Calculations are involved, but the superheating and desuperheating effect for specific conditions can easily be determined by means of a special chart described by the author

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AN UNUSUAL and hitherto relatively unimportant thermal effect in power plant work is the superheat resulting from cessation of flow. With modern central stations operating at steam temperatures which approach the working limit of the materials, it is obvious that any condition capable of bringing about a sudden temperature rise of up to 400 deg. F. is of genuine importance. Consider, for example, a plant in which the condititon of steam in the mains is 1200 p.s.i. absolute and 760 deg. F. If steam from such a line were permitted to flow into an empty receiver until the pressure in the receiver reached 600 p.s.i., the resultant temperature would be 940 deg. F.; if the pressure were raised to that of the line, the corresponding temperature would be 960 deg. F.

This superheat effect becomes more pronounced as the line temperature rises. With supply steam at 1200 p.s.i. and 1200 deg. F., the receiver temperature corresponding to line pressure would be 1560 deg. F.; an increase of something more than 360 deg. F. over the temperature of the steam leaving the superheater. The above examples serve to demonstrate what at first glance may appear to be a rather surprising fact. It is quite possible for the temperature of steam in a piece of equipment, remote from the boiler, to exceed by 25 percent or more, the steam temperature at the source.

It is beyond the scope of this paper to investigate the conditions under which this effect would prove of practical importance. Suffice it to say that at any place in the system where the flow is suddenly interrupted, whether in line or in equipment, there will be an immediate rise in temperature. The possibility that this effect may be of importance in the operation of such equipment as turbines, quick acting valves, boiler drums or superheaters is left to the judgment of the operating engineer.

Thermodynamic evaluation of the degree of superheat resulting from interrupted flow is based on an extremely simple principle. The standard Hirn's analysis for steam engines makes use of this principle as does the analysis used by refrigerating engineers in investigations of multi-effect compression. In brief, the thermodynamic statement of the reason for a superheat effect is that the internal energy of the vapor in the receiver must be equal to the enthalpy (heat content) of the vapor flowing through the line. Expressed in equation form,

$$i_r = h_l = i_l + AP_l V_l$$
$$= h_r - AP_r V_r \quad \text{.....Eq. 1}$$

where i, h, V represent specific values of internal energy, enthalpy and volume respectively, P is the pressure in pounds per square foot, A = 1/778 and the subscripts r and l refer to receiver and line.

From the above equation it is seen that the increment of internal energy $i = AP_lV$ and is therefore independent of the final pressure in the receiver. Thus the internal energy of the vapor at rest is the same whether its pressure is equal to, or less than, that of the vapor in the line. This fact can be most easily visualized by considering that the pressure reduction occurs while the vapor is still in motion and that it takes place, in effect, through an adiabatic expansion valve. Under such conditions the enthalpy in the line would be independent of pressure and therefore the internal energy of the vapor in the receiver would be the same regardless of the pressure in that section of the line from which it was supplied.

A solution of the problem by direct use of Equation 1 involves reference to the steam tables and a trial and error procedure. The method is simple, but time consuming. As an example consider live steam at 1200 p.s.i. and 760 deg. F. admitted to an empty receiver until the receiver pressure rises to 600 p.s.i. From the Keenan-Keyes Steam Tables the values of h_l, P_l, V_e, are 1353.2 B.t.u. per lb., 1200 × 144 lb. per sq. ft., and 0.5347 cu. ft. per lb. respectively. Then by Eq. 1,

$$i_r = h_l = 1353.2 = h_r - AP_rV_r =$$
$$h_r - \frac{144 \times 600}{778} V_r$$

This equation contains the two dependent variables h_r and V_r and so can be solved only by

trial and error. Assume a value of the receiver temperature t_r and for this temperature determine from the steam tables the corresponding values of h_r and V_r. Try these values in the equation and if it does not balance, make a second assumption for t_r and repeat the process. Usually three or four trials will result in a solution accurate to within a few degrees.

A more accurate solution is obtainable by plotting from steam table data t_r as a function of $h_r - \frac{144 \times P_r}{778} V_r$. Calculation for a few values of t_r will permit construction of a curve from which the exact value of t_r, corresponding to the known i_r, can be readily determined. The obvious objection to this method is that it necessitates plotting a separate curve for each particular problem.

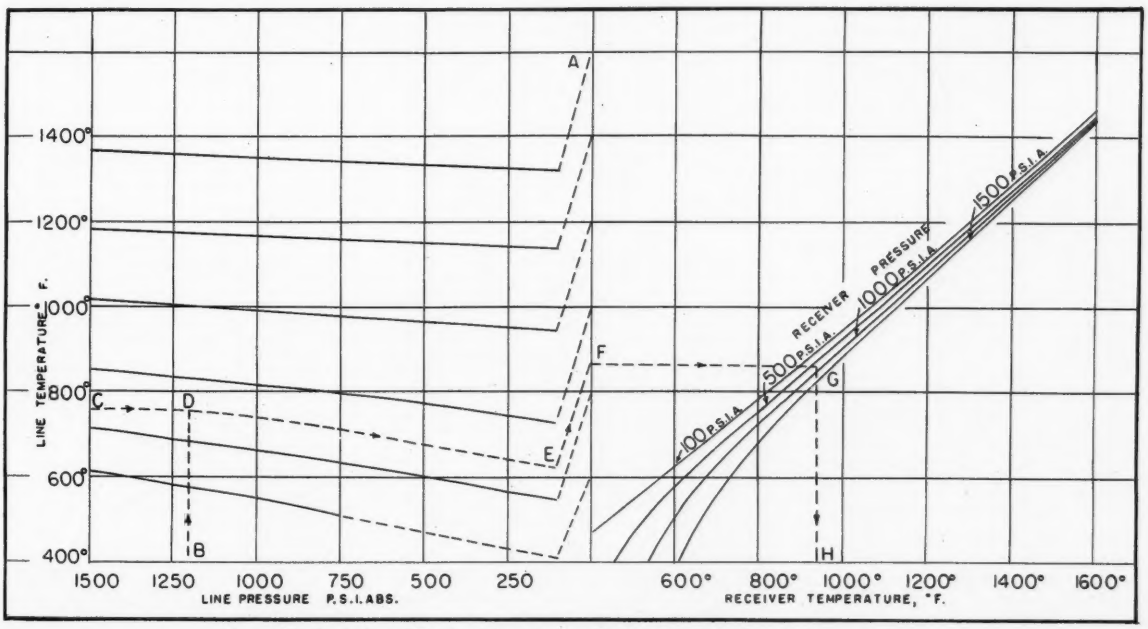
To reduce the time and effort needed to obtain an accurate solution of Eq. 1, the accompanying chart has been prepared. This is a graphical presentation of the relationships of the equation and permits direct and accurate solution of superheat effect problems without reference to steam tables or calculations of any kind. The example given above is shown also on the chart; the dotted lines indicate the method of entering and following through the chart and detailed explanation is also given below the figure.

The method of construction is extremely simple. The left side of the figure shows lines of constant enthalpy drawn on a temperature-pressure field. From the right hand end of each constant enthalpy line, a heavy dotted line carries up to the position for that value of enthalpy on the central, vertical, lineal scale. But since h_1 is equal to i_r, the central scale is a scale of enthalpy for the left side of the graph and a scale of internal energy for the right side of the graph. The right side plots lines of constant pressure on a temperature-internal energy field; the key to the solution is the superposition of central enthalpy and internal energy scales. Superposition obviates the need for values of either enthalpy or internal energy and it was therefore unnecessary to indicate numerical values of these quantities on the graph. For the same reason numerical values of the enthalpy curves in the left side of the graph have not been indicated; such values are unnecessary to the solution.

Grouping of pressure curves in the right side of the chart suggests the possibility of expressing the receiver temperature algebraically. Examination will show that for temperatures above 800 deg. F. (and pressures above 500 p.s.i.) a straight line will express t_r as a function of h with an accuracy of plus or minus 25 deg. F.

Use of the chart for solving problems in which flow is from, rather than to, a receiver is accomplished by following the same procedure already outlined, but in the opposite direction. In this connection it is noteworthy that the temperature drop between a receiver and some point in the line which it is supplying, is due only in part to line losses; in many cases a large fraction of the temperature reduction can be due to the desuperheat effect rather than to transmission losses.

Summarizing, the chart presents a simple graphical solution to problems of superheating or desuperheating due to flow into or out of a receiver, or, due to sudden starting or stopping of flow in a line or in a piece of equipment. The thermodynamic analysis back of the method is not new, but its application to problems in practice is now becoming of importance since steam power plants are working at steam temperatures which approach the allowable limit at which the materials can be safely used.

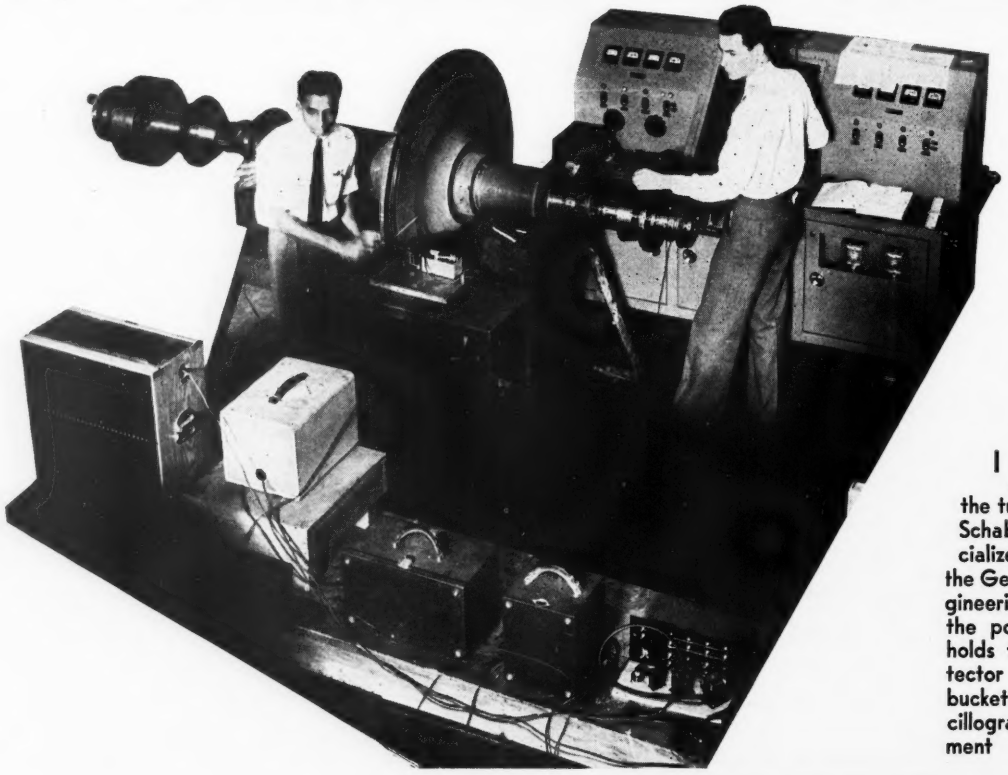


A graphical solution of Eq. 1, giving the superheat effect of steam entering a receiver

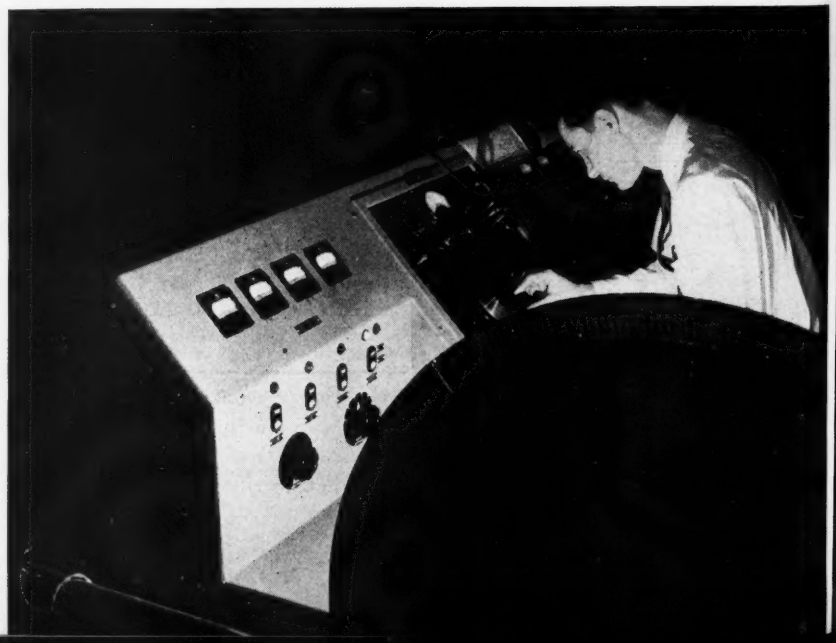
Example shown by dotted lines—live steam at 1200 p.s.i. absolute and 760 deg. F. is admitted to an empty receiver until the pressure rises to 600 p.s.i. The solution to find the receiver temperature is as follows: Enter the chart vertically at B (1200 p.s.i.), and horizontally at C (760 deg. F.) From the intersection of these two lines at D, follow down to E, parallel with the solid line curves, then upward parallel to the dotted line curves to F the intersection with the axis AA, horizontally to G (600 p.s.i) and vertically to H. Read the receiver temperature from the temperature scale as 940 deg. F. For problems involving flow from a receiver to a line follow the reverse procedure.

TAKING THE PULSE OF TURBINE BUCKETS

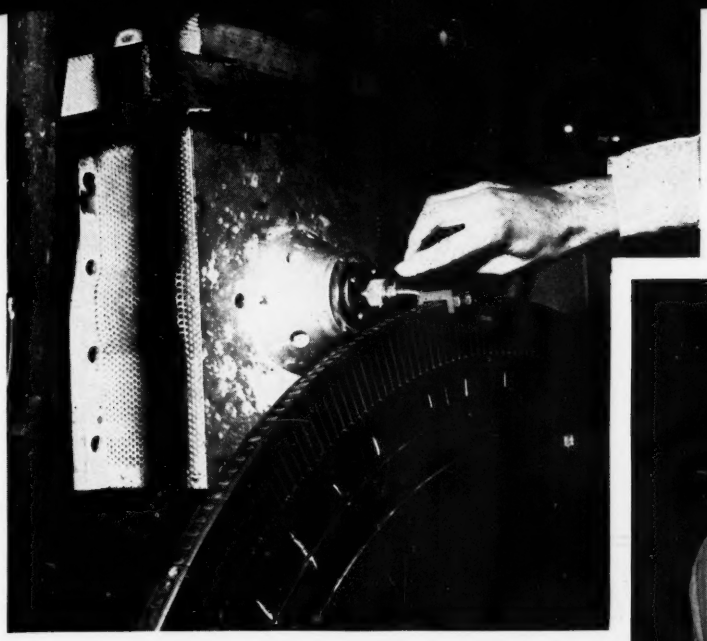
Turbine buckets have natural vibration frequencies or resonant points which, unless taken account of in design, may cause trouble in operation. The problem of producing and recording such vibrations has been solved by the General Electric Co. engineering laboratory which designed and built a 1,000-watt audio oscillator to produce power at frequencies from 30 to 20,000 cycles per second. This oscillator is now used to check parts used in General Electric turbines.



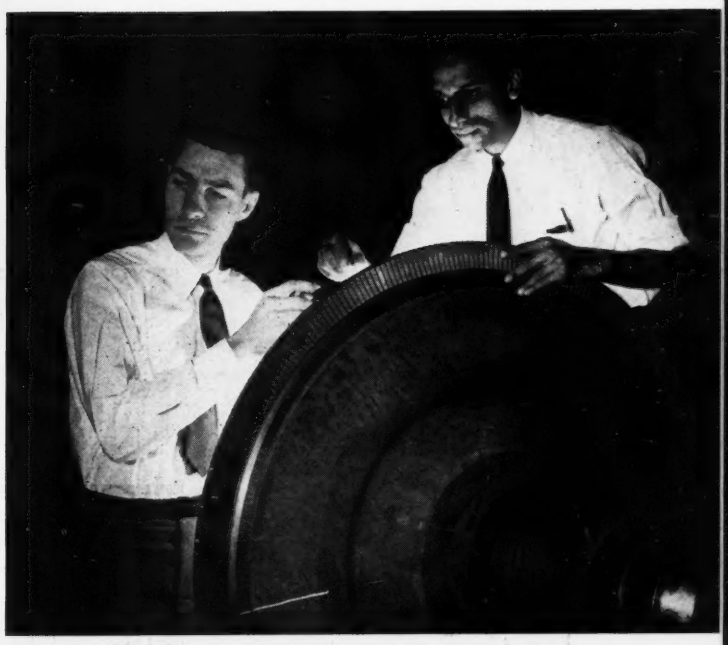
1 Left. The vibration equipment set up for the turbine bucket test. Carl Schabtach (right), who specializes in these problems for the General Electric turbine engineering department, adjusts the power while an assistant holds the hand vibration detector against the turbine bucket. The cathode ray oscillograph and other equipment occupies foreground



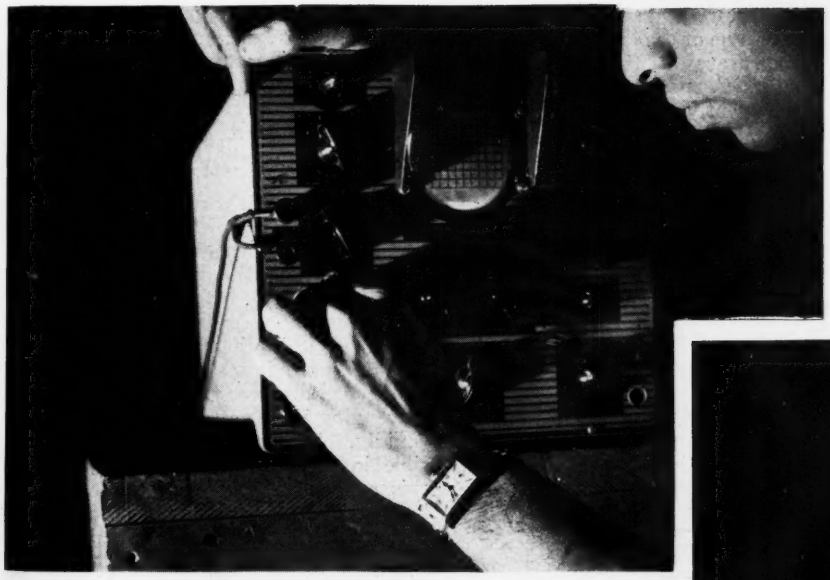
2 Right. The oscillator panel, for measuring frequency is but a small part of the elaborate power source. In addition to the oscillator in the center, the unit consists of 100 volt-ampere and 1000 volt-ampere amplifiers on either side of oscillator. Push-button control (left) makes for easier handling, and as the whole unit is on wheels, it is easily transportable



3 Left. Power furnished by the oscillator is applied to vibrate the turbine buckets at different frequencies by an overgrown loudspeaker attached to the buckets with the connecting rod shown being clamped in place in this picture



4 Right. As the turbine bucket wheel is vibrated, the engineer moves a crystal vibration detector along the buckets thus relaying the vibrations to an oscillograph, which he watches. The assistant marks the points at which peak vibrations occur



5 Left. On the screen of the oscillograph the vibration of the buckets is shown magnified 100,000 times. By watching the screen the operator can determine the frequencies at which the buckets tend to vibrate

6 Right. Another device for exploring the vibrations is a stethoscope with a specially constructed diaphragm. Users of this instrument hear a high penetrating hum at places on the turbine disc where the buckets are vibrating

Features of Diesel Engines With Opposed Pistons

Employing the two-stroke cycle with provision for scavenging, Sulzer Bros. have developed an opposed-piston Diesel engine that has wide application as a drive for high speed machines of all kinds

HAVING developed a Diesel engine design with opposed pistons for the purpose of obtaining good balancing of the moving masses, Sulzer Brothers of Switzerland found that this system possesses some excellent features which favor the adoption of the two-stroke cycle process in high speed engines; in addition the system presents space advantages.

Each of the horizontal cylinders contains two pistons which simultaneously approach to or move away from each other, i.e. they move in opposite directions. Each piston is connected to a rocking lever through short links. From these the forces are transmitted to the crankshaft arranged under the cylinders by means of connecting rods working beside each other in parallel planes. The crankshaft has two cranks per cylinder, displaced at 180 deg. to each other, and is supported in bearings at each end and between each two cylinders. The compression space is formed in the middle of the cylinder when the pistons are at their inner dead center. A special cylinder cover is consequently not required and the fuel, starting-air and compression-release valves are arranged radially direct on the cylinder.

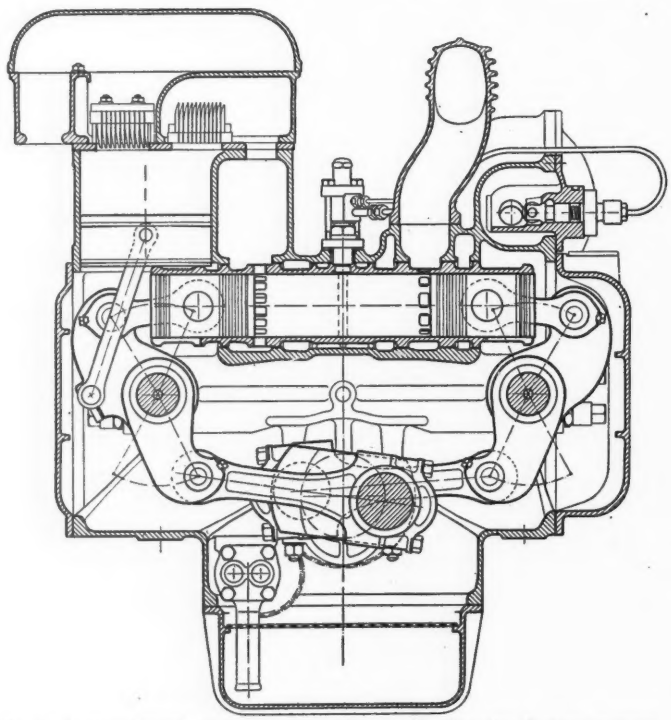


Fig. 1. Section through two-cycle opposed-piston Diesel engine showing scavenging side to left and exhaust side to the right

Shortly before the end of the working stroke one of the pistons uncovers the scavenging ports, and the other the exhaust ports. Each cylinder has its own scavenging-air pump, which can be seen to the left in Fig. 1, and is driven through a double connecting rod from one of the rocking levers. The air pumps draw the air through specially designed noise-reducing nozzles and deliver it into one common receiver, which communicates with the cylinders through scavenging-air ports arranged in such a manner that the current of air passing through them is given a certain turbulence. As soon as these ports are uncovered by the piston, fresh air will enter the cylinder to take the place of the products of combustion, which are expelled through the exhaust ports.

In two-cycle engines it is an advantage to have the exhaust ports uncovered a little before the scavenging-air ports, in order that the pressure within the cylinder may fall to approximately the atmospheric pressure and thus allow the scavenging air to enter the cylinder rapidly. It would have been possible in the present case to fulfil this condition by making the exhaust ports towards the middle somewhat longer than the inlet ports. But, on the other hand, it is also important that the scavenging air should continue to enter the cylinder after the exhaust ports have been closed, in this way increasing, as far as possible, the quantity of air available for combustion. Now, if the exhaust ports had been lengthened, this latter condition could not be fulfilled, for in this case the scavenging ports would be closed by the corresponding piston before the exhaust ports are closed. The motion of one of the pistons must, therefore, be some-

what displaced with regard to the other, which could be effected by setting the two cranks at an angle slightly less than 180 deg. from each other.

The principle of the horizontal engines with opposed pistons, however, gives another very simple means of making one of the pistons move slightly in advance of the other. This is done by setting the crankshaft somewhat deeper, so that when the crank and connecting rod of one piston are in line, the others still have a certain angle between them, as is shown in Fig. 2. Piston II is at the inner dead center, since the bottom end of its rocking lever has reached the extreme outer limit of its path. When the crankshaft rotates further in the direction of the arrow, piston II begins to move back again (working stroke). When on the other hand the driving gear to the left is examined, it will be seen that piston I has not yet reached its inner dead center. This it does only when the driving gear is in the position shown in dotted lines. But then piston II has already passed the dead center, it consequently runs in advance of piston I, while with the contrary direction of rotation it would remain behind.

With the crankshaft set still deeper, piston II would move still further in advance of piston I, since the angle α would be greater. This angle, however, is a measure of the extent through which the crankshaft must be rotated in order to come from the dead center position of one piston into the dead center position of the other. On the other hand, if the crankshaft is set higher, the advance of one piston with respect to the other would become less and less and finally disappear completely when the axis of the crankshaft falls within the horizontal plane passing through the bottom pins of the rocking levers in their outer dead center position. If the crankshaft were set still higher, piston I would then move in advance of piston II.

With this type of engine the designer is free to make one piston move in advance of the other to any desired extent by setting the axis of the crankshaft higher or lower. Naturally the piston that moves in advance will be the one at the exhaust side, so that the exhaust ports will be opened a short time before the scavenging ports, thus allowing the pressure in the cylinder to fall quickly to atmospheric. The exhaust ports will also be closed before the scavenging-air ports, so that a certain supercharging is effected. Because of this efficient method of scavenging and the intimate mixing of fuel and air ensured by the method of injection, the fuel consumption of 180 grams per b.hp.-hr. obtained in engines of this size at full load, the cylinder outputs are 20 to 30 b.hp. at 1000 to 1500 r.p.m., is to be considered as low.

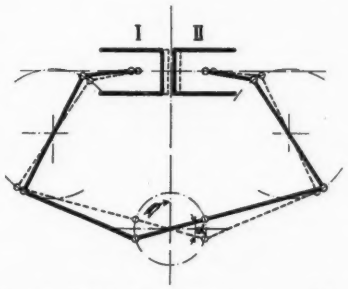


Fig. 2. Sketch illustrating how one piston travels slightly ahead of the other

Another advantage of the opposed-piston arrangement is obtained from the fact that the total stroke is divided between two pistons. It is consequently possible in this way to have an engine with a high speed of rotation, while the piston speed is kept low, thus prolonging considerably the length of life of the cylinder liners and pistons.

Control Members All Assembled on Iron Frame

The control members are all brought together on an iron frame which serves as cover to the camshaft trough so that the whole can be dismantled easily. The crankshaft operates the valve gear by means of a toothed wheel; this wheel drives another fixed on the camshaft. The ball governor acts on the fuel pump through a short linkage; with its help the speed of the engine can be adjusted within wide limits. The cams that control the fuel injection pumps are milled in the middle of the camshaft.

The principal parts of the engine are lubricated by means of a gear-wheel oil pump placed within the crankcase. The pressure of the oil is shown on a gage, set in position where it can be easily read.

Engines with two cylinders are started by hand; engines with three or four cylinders are usually fitted with a compressed air or electric starting device, but these latter engines may also be started by hand in an emergency. If desired, the two-cylinder engine may also be fitted with a special starting device.

The range of application of engines of this size is very extensive, particularly since the speeds of 1000 to 1500 r.p.m. allow them to be direct coupled to high speed machines such as centrifugal pumps, electric generators, rotary compressors, etc., and also to be built into vehicles. An engine must, however, be particularly designed to suit the various purposes for which it is required. Consequently, the so-called "block engine" has been developed, which includes all parts common to the different possible applications, and at the same time has all the connections required for fitting the various accessories which are added for special work.

The Norton Company Plant at Worcester

(Continued from Page 53)

The extension of the boiler plant to include electric generation, at least to the point where all the process steam required passes through the turbine, is highly desirable and in the case of the Norton plant considerable savings will be effected by the arrangement.

In closing it may be of interest to direct attention to one minor element in the operation of this high-pressure boiler plant which nevertheless has resulted in a substantial saving. This concerns a small locomotive used to move railroad cars throughout the plant property. About the time the plant went into service, a steam accumulator locomotive was purchased to replace a regular coal fired locomotive which had outlived its usefulness. This locomotive operates on the Ruth's accumulator principle. It is filled with steam at about 440 lb. pressure and with such a charge it can operate for about 4 hr. before the pressure runs down to 50 lb. The unit is merely run to a connection outside the power plant and connected to the high-pressure steam system. It is possible to charge the locomotive in 20 min. but this usually imposes too great a drain on the boilers so the charging time is ordinarily about an hour. Compared to a coal fired locomotive of similar size, this accumulator unit is very economical both in operating cost, since it required no fireman, and also in initial cost.

Sodium Pentachlorphenate Treatment For Cooling Water

Algae growth in spray ponds has been the source of many troubles in the handling of cooling water. Among the chemicals which have been used as algacides is sodium pentachlorphenate, the suitability of which as a substitute for the usually used chlorine is discussed in this article

By Max Gelfand

Chemist, Dallas Power & Light Co.

SINCE the advent of chlorine gas as an algacide in the Dallas Power & Light Co.'s 10,000,000 gal. spray pond and house service tank waters numerous defects had been found. Consequently, a study of sodium pentachlorphenate, as a substitute, was made to determine its suitability for this purpose. Sodium pentachlorphenate is an algacide which revealed properties more desirable than chlorine gas. The following tests were made to determine its:

1. Effectiveness for preventing algae growth.
2. Effectiveness for killing algae growth.
3. Effect of high temperature on its algacidical properties.
4. Effect of continual application of heat on its strength.
5. Effect with CO_2 gas.
6. Effect on metals.
7. Toxic effects.

TEST No. 1—Six samples of filtered spray pond water with no live algae growth present were treated with 0, 5, 10, 15, 20, and 30 p.p.m. sodium pentachlorphenate. Algae started growing in the sample containing 0 p.p.m. after about 14 days and continued growing throughout the duration of the test. A trace of algae growth appeared in the samples containing 5 and 10 p.p.m. at the 28th day of the test. No algae growth was apparent in the samples containing 15, 20, and 30 p.p.m. Observations were terminated at the end of 34 days. Analysis of the samples at this time indicated that the loss of sodium pentachlorphenate was negligible.

TEST No. 2—Six samples of spray pond water with live growing algae present were treated with 0, 5, 10, 15, 20, and 30 p.p.m. The algae in the samples containing 0, 5 and 10 p.p.m. sodium pentachlorphenate continued growing throughout the duration of the test. The rate of algae growth decreased in samples containing increased concentration of the algacide. The algae in the sample containing 15 p.p.m. continued growing for about 7 days before being stopped. The algae in the samples containing 20 and 30 p.p.m. stopped growing immediately and with lapse of time the algae seemed completely dead, as indicated in Fig. 2 taken on the 18th day of the test. The test was stopped after 26 days and analyses of the samples at this time indicated that any algacide lost was negligible.

Fig. 1. Algae growth in spray pond

The algae that was considered dead as a result of chlorphenate treatment was washed and placed in some distilled water to determine whether or not the plant growth could be rejuvenated. No renewal of algae growth was apparent during a test period of 14 days.

TEST No. 3—A concentrated solution of sodium pentachlorphenate was heated to the boiling point. The procedure of the above test was then repeated with the same results.

TEST No. 4—A sample of spray pond water containing 30 p.p.m. sodium pentachlorphenate was maintained at temperatures from 176 to 194 deg. F. for a period of 18 days. Analysis at the end of the

test showed that the loss of algacide was negligible.

TEST No. 5—An excess amount of CO_2 gas was bubbled through a sample of spray pond water containing 100 p.p.m. sodium pentachlorphenate. This procedure was carried on for several minutes at atmospheric pressure and did not cause precipitation of pentachlorphenate. The quantity of CO_2 gas used usually is not encountered in ordinary plant operation. Precipitation will occur when the sample is completely acidified.

TEST No. 6—New and polished pieces of iron and copper were placed in each of five samples of spray pond water containing 0, 20, 40, 80 and 160 p.p.m. sodium pentachlorphenate, as shown in Fig. 3. The rate of rusting of the iron decreased in samples containing increased concentrations of sodium pentachlorphenate. At the end of a 16 day test the sample containing 160 p.p.m. retarded the rusting of iron to a noticeable degree. The copper was not affected.

TEST No. 7—Toxic effects of sodium pentachlorphenate taken from "Toxic Effects Upon Rabbits of Pentachlorphenol and Sodium Pentachlorphenate" by Robert A. Kehoe, Wm. Deichman-Gruebler and Karl V. Kitzmiller. Conclusions from experiments on rabbits are quoted:

"The smallest lethal dose of sodium pentachlorphenate in aqueous solution or in a 1 percent sodium chloride solution when applied to the skin was 257 mg. per kg. expressed in terms of free pentachlorphenol; when administered by mouth the corresponding dose was 218 mg. per kg., and when given intravenously, 22 mg. per kg."

From the above experiment the following interpretation may be made. The smallest lethal dose for a 154 lb. man would be 18 gr. of sodium pentachlorphenate or 159 gal. of water containing 30 p.p.m. of the phenol compound when applied to the skin; 134 gal. of water with the same algacide concentration when given by the mouth.

"Daily doses of 10 c.c. of a 1 percent solution of pentachlorphenol in mineral oil (41 mg. and 42 mg. per kg. respectively) were applied to the skin of two rabbits. At the end of 4 hr. the excess material was wiped off with cotton and without further washings the animals were returned to their cages. Both rabbits survived 21 successive daily treatments, without illness, loss of weight, or injury to the skin."

Fig. 2. Comparison of algae growth in spray pond water treated with various quantities of sodium pentachlorphenate

From the above experiment the following interpretation may be made. 2.9 gr. of sodium pentachlorphenate or 26 gal. of 30 p.p.m. of the chemically treated water that has evaporated completely leaving the chemical on the skin will cause no illness or injury to the skin of a 154 lb. man.

In stock form sodium pentachlorphenate is rather harmless, however, the following precautions should be taken:

1. Do not inhale the dust (wear respirator).
2. Do not get in eyes (wear goggles).
3. Do not get on skin (wear protective garments).

If the chemical does come in contact with the skin any injurious effects may be prevented by washing with soap and water.

Sodium pentachlorphenate in spray pond water is very effective in prohibiting and killing algae growth, the amount needed for best results is about 30 p.p.m.

The chemical is not consumed in stopping algae growth and its algacidical properties are not reduced or adversely affected by heat.

This algacide is much more stable in solution than chlorine gas. Sodium pentachlorphenate concentrations in water are not decreased by continual application of heat. Chlorine gas in comparison does not stay in solution nearly as long in hot water as in cold water.

Absorption of CO_2 gas by spray pond water will not acidify the water enough to precipitate pentachlorphenol.

Solutions of sodium pentachlorphenate are not corrosive while chlorine gas is corrosive.

These conclusions are based on the tests that were made.

The cost of sodium pentachlorphenate treatment was determined using 10,000,000 gal. as the capacity of the spray pond and assuming an annual loss of 150,000,000 lb. of water by overflow.

The comparative costs of 15 and 30 p.p.m. sodium pentachlorphenate treatment vs. chlorine gas treatments are given in the table.

The saving noted in the table results from chemical costs. A further saving will be made because

Comparative Costs of Treating Cooling Water with Sodium Pentachlorphenate and Chlorine

	Sodium Pentachlorphenate	Chlorine	
Sodium pentachlorphenate concentration	p.p.m. 30	15	
Sodium pentachlorphenate for initial treatment	lb. 2500	1250	
Sodium pentachlorphenate for make-up	lb. 4500	2250	
Aug. annual chlorine consumption (1935-1938)	lb.		41,705
Cost of initial sodium pentachlorphenate treatment—at 17½c lb.	$ 437.00	$218.50	
Cost of sodium pentachlorphenate make-up —at 17½c lb.	787.50	393.75	
Total cost of sodium pentachlorphenate treatment (1st yr.)	$1224.50	$612.25	
Annual cost of sodium pentachlorphenate (after 1st yr.)	$ 787.50	$393.75	
Annual cost of chlorine			$1355
Saving (1st yr.)	$ 130.50	$742.75	
Saving annual (after 1st yr.)	$ 567.50	$961.25	

Fig. 3. Testing corrosion inhibitive action of sodium pentachlorphenate treated water

no extra equipment will be necessary. The chemical may be used in conjunction with the sodium hexametaphosphate now being used. In doing so, however, the sodium pentachlorphenate should be added first as a mixture of the two chemicals; in high concentrations, will tend to precipitate pentachlorphenol and convert the metaphosphates to orthophosphates in accordance with the following equation:

$$6C_6Cl_5ONa + (NaPO_3)_6 + 6H_2O = 6C_6Cl_5OH + 6Na_2HPO_4.$$

Tests for sodium pentachlorphenate were made colorimetrically employing 2-6- dibromquinonechlorimide as an indicator in buffered solutions at a pH value of 7.6.

A solution of boric acid and borax was used as a buffer.

Standards of known concentrations of sodium pentachlorphenate prepared from make-up water going to the pond and evaporated to the same solid concentrations of the pond water were compared to the samples in question. Standards prepared with distilled water produce more vivid colorations than those produced by natural waters.

The presence of 30 p.p.m. or more of the sodium pentachlorphenate may easily be detected by acidifying the water in question and precipitating the pentachlorphenol.

Candle Power, Lumens, Foot Candles

By John Q. Wendell
New Hampshire Gas & Electric Co.

IN CONSIDERING illumination standards the term one candle power means an amount of light equal to that given off by a standard candle.

For a uniform unvarying light course, the candle power is a fixed quantity. It makes no difference how far we are from the light or how much or how little of the light we receive. The fact remains that at the light source we have a light equivalent to a certain number of standard candles. Its magnitude in candle power is unchanged, whether the observer gets a little of the light, all of it, or none of it at all. A point source of light of one candle power emits light rays or flux uniformly in all directions in spherical space.

Going out into space a distance of one unit length from a point source of light, we find that the area of a sphere at that distance $= 4\pi r^2$ (where $r = 1$ unit) $= 12.56$ sq. units.

A lumen is the amount of light flux which falls upon one of these square units of area, and since there are 12.56 sq. units of area uniformly illuminated, 12.56 lumens must be given off by a 1 candle power source of light.

If we draw radii from our point source of light to the corners of each one of these 12.56 sq. units we will have 12.56 solid unit angles, hence we may say that a lumen is the amount of light flux contained in a solid unit angle, when the light source is 1 candle power. If the light source is 2 candle power then there will be just twice as much light flux in each solid unit angle and the total lumens given off will equal (2×12.56) lumens. From the above we arrive at the relation:

$$\text{Lumens} = \text{c.p.} \times 12.56$$

The foot length is the common unit of length used in light measurements. Hence, if the sphere upon which our light rays fall has a radius of one foot, we will have 12.56 lumens falling on 12.56 sq. ft. or one lumen per sq. ft.

One foot distance from a one candle power source of light gives an illumination upon a surface which is called a foot candle, but as explained above we found that under the same conditions we had one lumen per square foot. Therefore, lumens per square foot = foot candles.

Suppose we increase the radius of our sphere to 4 ft. Our candle power is a fixed quantity (1 c.p.). Our total lumens given off is (12.56×1). Our radius being increased 4 times (from 1 ft. to 4 ft.) the area of our sphere will be increased 16 times. Hence our total light flux of 12.56 lumens will have 16 times the area to fall upon at a 4 ft. radius than it did at a 1 ft. radius, and since we had (1) lumen per sq. ft. with a (1) ft. radius, we will have 1/16 lumens per sq. ft. with a 4 ft. radius, or 1/16 foot candles.

Suppose we call the radius of any sphere (d) and let c.p. = the candle power of our light source.

Total lumens given off = c.p. $\times$ 12.56.

Total area upon which these lumens fall $= 4\pi d^2$.

Lumens per sq. ft. = foot candles =

$$\frac{\text{c.p.} \times 12.56}{4\pi d^2} = \frac{\text{c.p.}}{d^2}$$

(Where d = the radius of the sphere or the distance of the observer from the light source.)

Hence we arrive at our second fundamental relation:

$$\text{foot candles} = \frac{\text{c.p.}}{d^2}$$

The foregoing is based on a point source of light radiating light flux uniformly in all directions, with no light absorbed or reflected in the surrounding medium.

If we multiply candle power by (10) and not 12.56 we will get the approximate lumens given off by a light source, and give an allowance for some light flux lost in the transmitting medium.

GAS EXPLOSION PRESSURES

By means of high speed engine indicators the effect of gas concentration on explosion pressures was studied as part of an investigation of rupture discs for the protection of air compressor receivers and pressure vessels. Results were reported by the author before a recent meeting of the A.S.M.E. Because the rupture disc research is not yet completed, only that portion dealing with gas explosions appears below. The gas used was propane

By Merl D. Creech
Black, Sivalls & Bryson, Inc.
Oklahoma City, Okla.

EVEN THOUGH air compressor receivers and pressure vessels are provided with relief valves as a safeguard against overpressure, this does not protect them from the rapid pressure rise during an explosion of their contents. Since the relief valve does not protect them and it is obviously impossible to prevent an occasional accidental explosion, it seemed to be worth while to investigate the ability of a rupture disc to relieve harmlessly the explosion pressure.

Experimental work which has been done previously on combustion explosions was investigated. While it was found that considerable study had been given to combustion explosions in small bombs, little work had been done using larger closed vessels. Propane and compressed air constituted the explosive mixture chosen for these larger scale tests, not because it is exactly similar to explosive mixtures likely to be encountered in practice but because propane is easy to obtain, its properties are well known, and it is readily mixed with air to form an explosive mixture. It was felt that if preliminary results proved favorable, a study of more specific types of explosive mixtures could be undertaken later. Results were promising and it is intended to study in more detail specific examples of explosive mixtures as actually encountered in industrial applications.

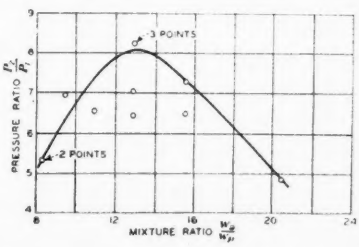


Fig. 1. Data showing the effect of air-fuel ratio on explosion pressure; P_1 is the initial compression pressure; P_2 the maximum explosion pressure; w_a the weight of air in the mixture; and w_p the weight of the propane vapor in the mixture

The explosion vessel used was specially constructed of arc-welded 1⅝ in. thick high-tensile-strength steel, 24 in. inside diam. by 10 ft. high, designed for a safe working pressure of 2000 p.s.i. The top consists of a special flange arranged to have various-size rupture discs bolted to it. A fan in the vessel promotes turbulence and creates an intimate mixture of the explosive vapor and the compressed air. The explosive mixture is ignited by means of a specially constructed spark plug using a 30-a fuse strip, connected across a 110 v. a.c. circuit. When the fuse melts, the arc formed ignites the explosive mixture.

Fuel was liquefied propane, such as is sold commercially for domestic gas appliances. The amount of fuel used in any explosion was determined by measuring the partial pressure of the vaporized propane in the explosion vessel with a mercury manometer. After the required amount of propane had been admitted, the vessel was charged with compressed air to the preselected initial compression pressure.

A pressure of 45 p.s.i. ga. was used as the combined pressure of the propane and compressed air in the first series of tests shown by Fig. 1 and covering an air-fuel ratio. The amount of propane in the explosive varied from approximately the lower to nearly the upper explosive limit. Data taken from indicator diagrams for these tests are plotted in Fig. 1 to show the relation between the air-fuel ratio and the ratio of the maximum explosion pressure to the initial compression pressure.

The ratio of maximum explosion pressure to the initial compression pressure was greatest when a mixture of 12.8 parts of air to 1 part propane by weight was used. The rate of pressure rise was also found to be a maximum for this mixture. Since the air-fuel ratio of 12.8 to 1 gave the highest explosion pressure and the maximum rate of pressure rise, it was used in all subsequent experiments. Having selected the air-fuel ratio to be used, a series of tests based on this air-fuel ratio was made with varying initial compression pressures. The relation between the initial compression pressure and the maximum explosion pressure is plotted in Fig. 2.

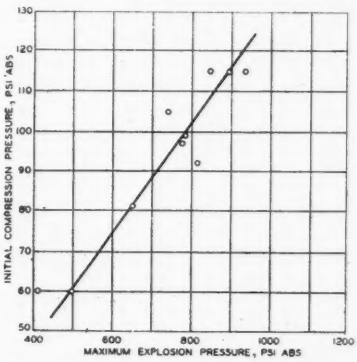


Fig. 2. Data showing the relation between initial compression pressure and maximum explosion pressure for an air-fuel rate of 12.8 to 1, the maximum point of the curve in Fig. 1. The maximum explosion pressure is roughly eight times the initial compression pressure

An examination of the data plotted in Fig. 2 indicates that the relation between the maximum explosion pressure and the initial compression pressure in a closed vessel is linear for the range of pressure covered, the maximum explosion pressure being approximately 8 times the initial compression pressure. Rupture discs ranging from 4 to 24 in. diam. were tried. These kept the maximum pressure to lower values ranging from 25 to 50 percent of those shown by Fig. 2. In general the small discs showed higher pressures than the large ones under comparable conditions.

Electrical Features Of

Vancouver, B. C.'s, magnificent new hotel has a number of electrical features of particular interest because of the way original specifications were changed during the 10 yr. involved in its construction. Direct current is generated by engine driven generators while alternating current is purchased from the B. C. Electric Railway Company

By FREDERICK H. FULLERTON

ONE OF THE interesting things about the mechanical and electrical installation of the new Hotel Vancouver in Vancouver, B. C., is the way in which the ideas of the original engineers and the original specifications were changed and brought up to date during the 10 yr. elapsing between the start of its construction and its hurried completion last year.

The Canadian National Railway built this hotel in discharge of an old agreement with the city of Vancouver. The "Canadian National" is government owned and work on the structure progressed very slowly. During the last year of its construction, however, an agreement was worked out with the competitive Canadian Pacific Railway whereby the latter agreed to close down its existing Hotel Vancouver and to operate the new hotel jointly with the C. N. R.

This, briefly, explains the long time involved in bringing the work to completion. The passage of a decade represented considerable development in the mechanical and electrical field and in order to keep the installation up to date, considerable revision of the original contract and specifications was necessary.

One of the main revisions involved a re-arrangement of the electrical system to enable single phase 110/220 v. 60 cycle current to be used exclusively throughout the lighting distribution system of the hotel either from the three steam driven direct current generators or from the power lines of the B. C. Electric Railway Co.

Under this arrangement the two 400 kw. and one 300 kw. Crompton Parkinson 110/220 v. direct current generators are not called upon to deliver 3-wire lighting energy to the hotel distribution system, but only to furnish 220 v. d.c. power for the motors and elevator drives throughout the building.

The direct current energy from these three generators, in addition to supplying the d.c. motor circuits, is used for driving the two 300 kw. auto-synchronous motor generators. These two ma-

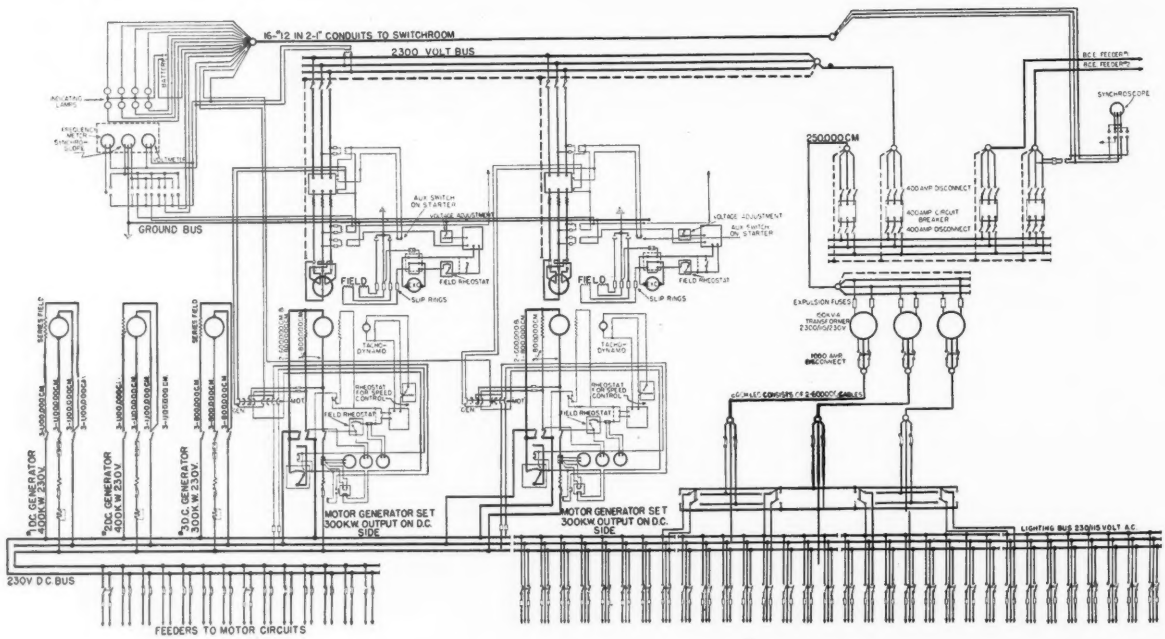


Fig. 1. Simplified general wiring diagram of the electrical connections

The Hotel Vancouver

Fig. 2. Operated jointly by the Canadian National and the Canadian Pacific Railway Systems, the new Vancouver is the finest hotel in the entire Northwest

chines consisting of 110/220 v. d.c. motors and 2300 v. a.c. generators serve as the connecting link between the a.c. and the d.c. systems. Originally the flow of power had been planned to be from the a.c. side to the d.c. side. In changing the system the original machines were retained and it was only necessary to make certain readjustments in the switching and control system.

In the original scheme, the generators were 2-wire compound wound machines. While it is still desirable that when occasion demands power can flow through the motor generators as originally intended, namely to have the a.c. side motoring and the d.c. side generating; under the new arrangement the flow from d.c. to a.c. is the normal condition. Only when the d.c. generators are unable to generate sufficient power for the motors will the power flow from a.c. to d.c.

The difference in the output from the d.c. machines compared to the input on the motoring side is not a serious factor. Both the a.c. and d.c. units were designed for 40 deg. rise and guaranteed to operate with a 25 percent overload for 2 hr. without heating. The a.c. units are of larger size than the d.c. units since, when motoring, the a.c. machines have to supply the losses in the d.c. machines in addition to the power delivered. Based on an a.c. efficiency of 94 percent the d.c. output as a motor, when called upon to drive the a.c. unit as an alternator, would not have the capacity to supply the losses as well as the output of the a.c. unit as a generator by this 6 percent. It follows from this, that instead of having a 25 percent overload capacity for 2 hr. at 300 kw., it can only furnish 282 kw. plus 25 percent overload for 2 hr. The set, therefore, must be regarded as having a capacity of 282 kw. continuous and 350 kw. for 2 hr. when operating in the reverse direction.

The general arrangement of the electrical system is shown in the accompanying diagram of connections. In order to equip the plant to correspond to the above power flow requirements, it was necessary to make provision which would enable the compound winding to be cut out when the d.c. end was motoring. Provision also had to be made for starting up either of the d.c. machines from the d.c. side with a standard type of d.c. starter. This starter must be cut out in the normal running condition.

When the unit is transforming d.c. to a.c. power, provision has to be made for a.c. voltage regulation by means of voltage regulators, and it is also necessary to provide for close frequency regulation. This has to be taken care of by special equipment on the d.c. side, and it has been done by means of a motor driven shunt field rheostat connected into each of the d.c. units. These resistances are controlled by means of a relay device operated from a frequency relay type of movement. The motor control on the shunt field rheostat is also designed to prevent hunting and over-running.

Direct current ammeters on the d.c. side have center zero movements, so as to read both ways, and d.c. watt-hour meters on these sets were eliminated and two watt-hour meters provided on the a.c. side of each unit. These watt-hour meters are provided with ratchet escapements and connected to read power passing through

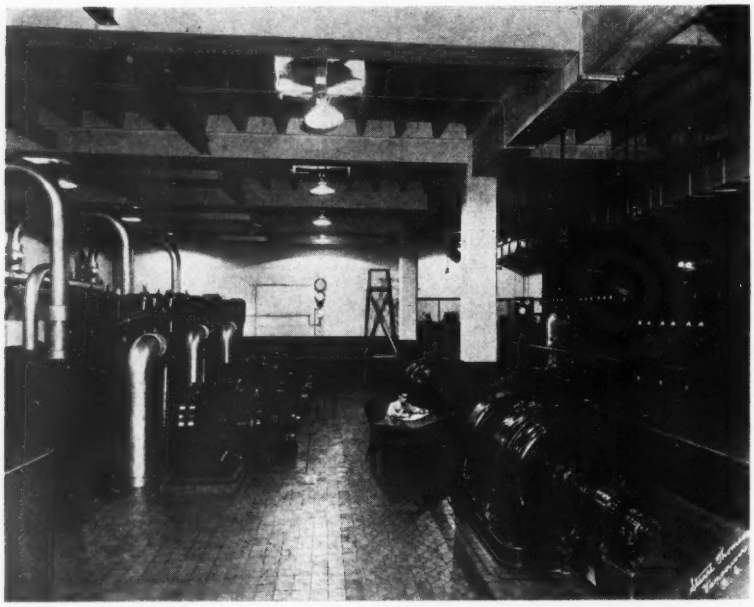


Fig. 3. A view in the engine room showing the synchronous motor-generators and the switchboard

them in opposite directions, that is to say, one movement reads a.c. power input from the B. C. Electric's supply system, and the other meter reads a.c. power output from the units when generating.

It was possible to take care of synchronizing between the a.c. generators without any special equipment as the a.c. units were designed as motors with their own starting equipment, and when one is running the other can be started up from it in the ordinary way from the a.c. side. The d.c. machine can then be switched for motor operation and the d.c. unit paralleled with the d.c. buses with its voltage slightly below the d.c. bus voltage. The unit then becomes converted from d.c. to a.c. power, the amount covered being determined by the shunt control of the d.c. machine.

There are two a.c. incoming services from the power company supplying the main a.c. bus. The switches controlling these services are interlocked to prevent more than one being closed at a time. In order to synchronize the a.c. generators with the power company's system a small synchronizing panel was installed in the switching sub-station and provided with a synchroscope and two sets of receptacles and one synchronizing plug. The one set of receptacles is connected to one power company feeder, and the second set to the other. In order to give the operator at the main power switchboard means for controlling the frequency a second synchroscope was installed in parallel with the synchroscope in the switching sub-station, whereby the operator can determine his phase relationship between the hotel units and the power company's system, and while he will not be actually doing the synchronizing, he will nevertheless be able to judge when this is done. In order to give him positive indication, an indicator was provided on the main switchboard which will show the position of the switches controlling the power company's feeders, that is to say it indicates whether these switches are individually opened or closed, and during synchronizing, as the operator in the switching sub-station closed his switch to parallel the two a.c. systems, the indicator on the switchboard shows that the feeder system is closed, which has been used for paralleling.

B. C. Electric Co. power is delivered to the hotel transformer vault at 2300 v. and stepped down by a bank of 2300/110-220 v. transformers of 100 kv-a. each, while there are three similar transformers of 75 kv-a. each in reserve. All six transformers, except for capacity, are identical products of the Packard Electric Co.

The steam driven generators comprise one 300 kw. and two 400 kw. machines, all Crompton Parkinson units.

Power generated by the hotel plant is capable of supplying light equal to that used in 11,000 average homes. The main switchboard is the largest of its type in British Columbia, it being 52 ft. long and 7 ft. high. At least 75 percent of the equipment was designed and constructed in Vancouver and the remaining 25 percent of the board's equipment was made in England.

General Features

There are two telephone systems in the hotel, one a main system installed in guest rooms and connected with the B. C. Telephone system and the other an inter-departmental automatic system. Each dining room, banquet hall, salon suite, etc., is completely equipped with a three channel public address system and every bedroom is wired for use of a standard radio receiver. Some 600 radio sets can be in operation at once, all connected to a master antenna system.

Special attention was given to the lighting system throughout the hotel. Many new features and lighting arrangements are provided in the public rooms. As an example, the panoramic roof garden dance floor on the 15th level is decorated with invisible colored lights giving any desired color effect and with the intensity regulated by thyratron tubes.

The spectacular painting with lights concealed in the walls, in the rails of the balcony, around the stage, in the light troughs around the tops of the pillars and elsewhere gives possibilities of almost infinite change in design and tints, and is accomplished by the use of many of the types of color filters available. Brightening and dimming of the primary colors, red, blue and green permit a continuous variation of tints and shades covering the full range of the spectrum. The dimming of one color as another color is brightened produces many surprising and artistic effects.

On the whole the electrical features of this magnificent hotel are as modern and up-to-date as though the structure was designed 1 yr. instead of 10 yr. ago. Supervision of the entire electrical installation was in the hands of Norman Watson who joined the Canadian National Railway in 1926 and who was transferred to the Architect's Department at Montreal in 1929.

STEAM TURBINE LUBRICATION

A decade or more ago sludging of turbine oil, due primarily to oxidation, was not an uncommon complaint. After the source of the trouble was determined oil companies soon developed non-sludging oils and operators took pains to keep the acidity, which gradually develops under the continued action of heat and moisture, under control. After a period of several years, trouble again developed in a different direction—corrosion of steel parts when starting up new turbines.

Present methods of oil refining remove the substances which wet or form a coating on the metal surfaces, these surfaces unprotected by an oily film, fall prey to any moisture present. After a period of service, fatty acids are formed by oxidation of the oil and act as rust inhibitors. As before, once the cause was determined a remedy soon followed. This was found to be a rust inhibitor added to the new oil, zinc stearate or other compounds added to the oil for a breaking in period only, or, mixing a small amount of old oil with the new.

This last method and the reason for it was covered in some detail by the author recently before the A.S.M.E. The following abstract, while it refers specifically to General Electric turbines, contains a great deal of practical information about steam turbine lubrication and simple oil testing methods.

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BECAUSE turbine oils with variety of physical characteristics are functioning well in steam turbines, the General Electric Co. issues only the relatively broad recommendations shown in Table I, purposely made to include well-tested products of many oil companies, they are so broad that they may include not only good but also poor oils. For this reason, it is suggested that the oil to be used should have a good service record in the field. Further requirements not mentioned in Table I state that the oil should be a petroleum derivative free from water, sediment, soap, and resins or any materials which in service will prove injurious to the oil or to the turbine with its accessory equipment.

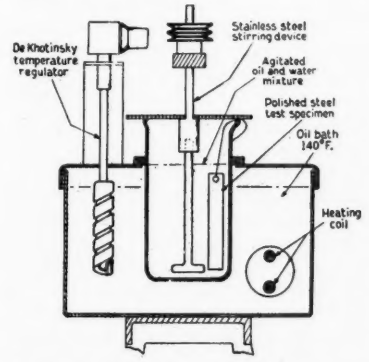

Fig. 1. A simple oil corrosion testing apparatus, the Kuebler tester with a constant temperature oil bath added

Slopes of temperature-viscosity curves when plotted on special A.S.T.M. paper for different fractions of oils obtained from the same crude are approximately equal and the lines are therefore parallel. However, the lines from the fractions of another crude although parallel to each other may have slopes different from those of the first-mentioned series. Pennsylvania oils have a gentler slope than do coastal oils. Dean and Davis in 1929 gave to all the oils in the last-named group (coastal) a viscosity-index number of zero and gave all those in the first series (Pennsylvania) a viscosity-index number of 100. At that time the viscosity-index number of all other oils fell between these two limits.

Viscosity Index

Since 1929, many oils, having a gentler viscosity-temperature slope than the Pennsylvania oils used in the formula, have been placed on the market. These new oils, therefore, have viscosity indexes of over 100. There are also oils on the market which have steeper viscosity-temperature lines than those of the series of coastal oils used in the formula. These oils have negative viscosity indexes.

This brings up the controversial question as to whether a high viscosity index oil is better than a low viscosity index oil in a turbine. While the tendency among steam-turbine operators is to use oils with high viscosity indexes, we know of successful operations with low viscosity index oils. So far as it is possible to judge from data obtained up to the present time from the field, either type of oil may be used, provided it is refined in such a way that it is satisfactory in other respects.

Table I. Lubricating oil specifications recommended for G.E. turbines

Properties	Land and marine direct-connected turbine-generator sets	Land gear sets and oil-ring lubrication, turbine-generator sets
Saybolt viscosity, sec:		
at 100 F	140–170	280–325
at 120 F	.....	.....
at 210 F (approx)	43	49
Flash point, F (min)	330	350
Neutralization number	0.05 Max	0.05 Max
A.S.T.M. steam-emulsion number	90 Max	90 Max
Maximum viscosity before starting, sec	800	800
Minimum oil temperature before starting, F	50	70
Operating bearing-inlet oil temp, F	110–120	110–120
Operating bearing-outlet oil temp, F	140–160	140–160
Minimum oil-tank temp, F	130	130

The organic-acid content of an oil is expressed as the number of milligrams of caustic potash required to neutralize the acids in 1 g. of oil. The value obtained is called the neutralization number of the oil; the higher the neutralization number, the greater of course is the acid content of the oil. Although the suggestion is

made in the recommendations that a new oil may have a neutralization number as high as 0.05, many oils on the market have a neutralization number practically of zero. As an oil slowly oxidizes in use, organic acids are gradually formed and the neutralization number rises. Under exactly the same operating conditions, the rate at which one oil will oxidize may be quite different from the rate at which another oil will oxidize.

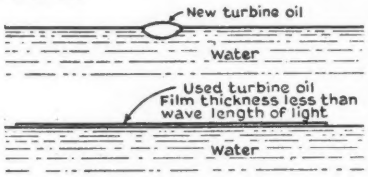

Fig. 2. The spread of an oil drop on water has been found to be an excellent measure of its rust preventive qualities

Oils derived from some crudes seem to have in them natural oxidation retarders which slow down the rate of oxidation over what it would be if the retarders were not present. Then, too, a few oils on the market have oxidation inhibitors purposely added to them which, under selected conditions, bring down the oxidation rate to an exceedingly low value for long periods of time.

Efforts displayed by many oil refiners in recent years to reduce their turbine-oil neutralization number down to zero is praiseworthy in so far as effort is concerned. However, there is evidence that many of these oils, with a neutralization number of zero (no organic acid present) in combination with water, have given rise to excessive iron corrosion within oiling systems, such corrosion products being carried along and interfering with the operation of governors and other parts depending upon close tolerances.

The corrosion product formed on iron parts in contact with a small amount of water disbursed through certain turbine oils is generally black and is magnetic. Although not a true rust, it is called rust by most turbine operators. This corrosion has been so considerable in some cases that oil suppliers have been accused of furnishing oil which was prone to sludge, whereas, in such cases, it was probably too highly refined as far as retention of natural corrosion inhibitors was concerned.

Of course, from an operator's point of view, a quantity of iron corrosion mixed with oil is a sludge, even though an oil man might not consider it as such. Moreover, a large amount of iron oxide in oil certainly will act as a catalyzer when the oil does start to oxidize. After this, an actual oil sludge may develop rapidly.

New vs. Old Oils

It has been noticed in recent years that the turbine installations with new turbine oil were the ones which sometimes corroded. Old ones with used oil never corrode for a turbine oil tends to improve in service, as far as corrosion inhibition is concerned.

With the modified Kuebler apparatus, shown by Fig. 1, several remarkable facts have been developed concerning the oil which we use in the turbines in our Schenectady Works powerhouse. We found that the new unused oil will, when agitated with water, allow rust to form on iron, whereas oil which has been in use in the same turbines for several years and which has a neutralization number of 0.7 will inhibit rusting.

We also found that this used turbine oil is a very effective rust inhibitor when it is mixed with new oil in proportions even as low as 1 percent of used oil to 99 percent of new oil. With new oils which are not rust inhibited, we would suggest that provided the oil supplier approves of it, a small addition of a well-used oil of the same brand be added to the new oil when first putting a new turbine into service. The oil supplier can specify the amount of old oil to use. As a rule he will be cautious about specifying a large amount of old oil because even slight additions of old oil to new will lower appreciably the life of that new oil, considered from an oxidation standpoint.

Theory of Rust-Inhibiting

In our laboratory, we have found recently the rust-inhibiting quality of turbine oil, developed in service, is in some way connected with the formation of hydrophilic groups by oxidation of the oil. Following Dr. Langmuir's procedure with oil films on distilled water, we found that new turbine oils which permitted iron corrosion in our laboratory tests did not spread when dropped on water, whereas a drop of the same type of oil used for several years in our factory turbines spread over the surface of water like a flash, as shown by Fig. 2.

All new oils on test, with rust-inhibiting properties, spread on water to a greater or lesser degree. It requires 5 min. for the drops of some of these to double in diameter, while others spread almost as rapidly as used oils. Since, theoretically, organic acids of all manner of molecular weights are produced when mineral oils are oxidized, we carried out the experiment of adding 0.25 percent of various aliphatic acids to a neutral white oil, not with the idea that these particular acids are formed by oxidation in the oil, but solely to provide a clew as to what molecular-weight organic acids were giving rust inhibition, and what molecular-weight acids might give rise to rusting. It was found, as might be expected, that the acids of lower molecular weight, such as formic, acetic, and even propionic, were rust producers. In fact, more rust was produced by such acids than by a neutral untreated white oil.

Ascending the scale of acids, complete protection was found through the use of 0.25 percent caproic acid, having a molecular

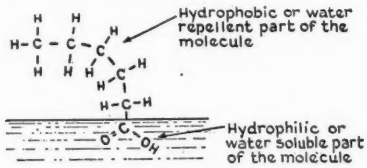

Fig. 3. Action of caproic acids as a corrosion inhibitor

weight of 116. All acids of higher molecular weight, such as caprytic (144), palmitic (256) and steeric (284) acids, also give protection. Later experiments indicated that 0.1 percent of caproic acid was equally effective.

Figure 3 gives the structure of one of the forms of caproic acid and illustrates how caproic acid or any organic acid of higher molecular weight tends to inhibit iron corrosion in contact with water suspended in oil. The water-soluble or hydrophilic part of the molecule of organic acids is called the carboxyl group. This is the same group which attaches itself to iron surfaces. After a layer of such molecules has become attached to the iron, the oil soluble or hydrophobic parts of the molecules are presented to the oil and prevent water globules, suspended in motion in that oil, from coming

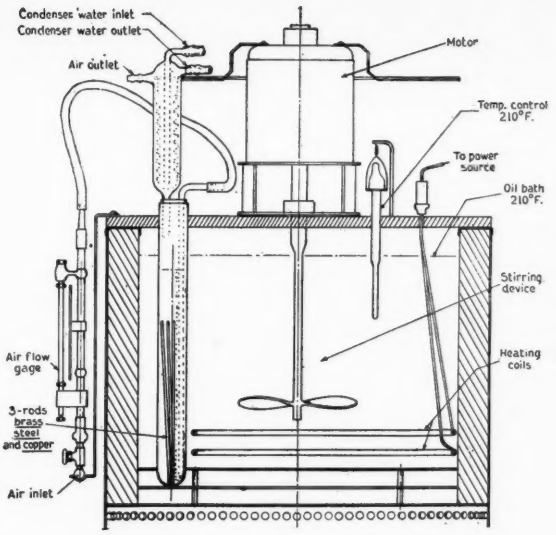

Fig. 4. Iron, brass and copper are active catalyzers of oxidization in oils. This apparatus is used in a modification of the Farmer test for oil oxidization. Three metal rods are immersed in a heated tube of oil and water and kept agitated by air. The surrounding oil bath serves to keep the temperature constant

in contact with the iron, thereby inhibiting rusting of the iron.

Other Sources of Rust-Inhibition

Organic acids are not the only oxidation products of oil which inhibit rusting of turbine oils since, while the organic acids are being formed, there are probably compounds with hydroxyl groups and ketone groups which are likewise hydrophilic and capable of wetting the iron. It may therefore be possible to treat a new oil with the non-acid oxidation products of mineral oil and, thereby, effect iron-corrosion inhibition without raising the neutralization number.

Because the traces of organic acids and associated oxidation products in turbine oils tend to inhibit rusting under turbine-operating conditions, it must not be assumed that a used turbine oil, for example, can be used as a rust-inhibiting coating for iron or steel under all conditions. Such an oil-treated specimen if placed out in the rain or in salt water would certainly rust.

A possible explanation for this may be that, although the protective molecules on the iron are packed closely enough to keep water in fine globules in suspension in oil away from the iron, large and heavy globules not in rapid motion will tend to break through the film.

Another point to be seriously considered is that too high a content of free organic acids in a turbine oil is detrimental, in that it may give rise to or be associated with: the formation of metallic soaps; formation of permanent water emulsions; sludging of the oil; or destruction of oxidation inhibitors.

The maximum permissible amount of free organic acid in an oil depends upon the type of oil used. With oils having antioxidants present, the amount of acid permissible should probably not exceed that which corresponds to a neutralization number of 0.15. With no antioxidants present and depending upon the oil used, an amount equivalent to a neutralization number of 2.5 might be permitted.

The carboxyl groups which, in an organic acid are responsible for inhibition of rusting, are also responsible for attack on metals and oxides of metals forming soaps which are almost insoluble in both oil and water. Most of these metallic soaps act as active catalyzers for the further oxidation of the oil.

A high percentage of organic acids and associated oxidation products give rise to permanent emulsions of water in oil because there is a sufficient number of the hydrophilic groups present to take care of the large contact area between the water globules, which constitute the discontinuous phase of such an emulsion, and the oil which constitutes the continuous phase.

High acid values in oils are associated with sludging of such oils. Such sludges are insoluble oxidation products of the oil. One of the best tests for oxidation characteristics of an oil has been developed by Harold Farmer who pointed out that iron, brass and copper, particularly the last, are active catalyzers in speeding the oxidation of turbine oil.

We are using a modification of the Farmer test, as shown by Fig. 4. In this 400 mil. of oil are placed in a Pyrex tube with three ⅛ in. diam. rods, 10 in. long, of three different metals, i.e., iron, brass, and copper. In the same tube at the start of the test is placed 12 c.c. of water. Examination of the tube is made daily to assure that approximately that amount of water is present. The oil and water are maintained at 210 deg. F. and, through the oil and water, air is bubbled at the rate of 10 liter per hr.

Samples of oil are tested once a week for neutralization number, viscosity, and precipitation number. The viscosity sample is returned to the tube.

While we find that wide variations exist in the oxidation rate of different oils, at present there is no inclination to condemn some oils which do not prove to be among those giving the best results in this apparatus. The oil, for example, which we are using successfully in the Schenectady Works turbines cannot be graded as excellent from the oxidation standpoint. On the other hand, we appreciate that the oxidation-inhibited turbine oils now on the market are a valuable contribution to the turbine industry.

Beware Ammonia Hazards

To prevent painful, dangerous injuries, and release of even a small amount of ammonia under pressure:

Never open a compressor cylinder or release packing in the stuffing box until the cylinder has been pumped out and a valve opened to the outside air. Do not stand in front of a cylinder head when compressor is in operation. When opening valves connected to a gage glass of ammonia equipment, protect your eyes and face. Screw bonnet ammonia valves, when being opened after being jammed shut, sometimes come loose at the bonnet. Be sure the stem is turning in the packing (not the whole bonnet turning) when opening such a valve.

If you open an ammonia valve which discharges near by, stand by the valve until necessary to close it again. If you should leave, a dangerous concentration may be built up and you may not be able to return. Learn how to give first aid for ammonia burns. Learn prone pressure resuscitation.

RAPID FREEZING— Without

Rapid freezing, a desirable factor, in the freezing of many commodities, is not entirely a function of low temperature. Low temperature in fact is to be avoided if the rapidity of freezing can be attained without it. In this article which is the substance of a discussion before the N.A.P.R.E. the author considers the factors to be attained in the rapid freezing of food commodities.

By R. L. PERRY[2]
Division of Agricultural Engineering
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RAPIDITY of freezing has been shown to be essential in producing high quality results with certain commodities, and to be desirable with all.[3 4 5 6] The capacity of a given size of freezing unit is increased by faster freezing, so that a smaller plant is required per ton of daily capacity.[7] Extremely low temperatures should, however, be avoided.

Rapid freezing results from a proper combination of three principal factors. First, a large difference in temperature between the commodity and the refrigerating medium (air, liquid, or contact plates) promotes heat exchange. Second, a low thermal resistance permits heat to escape readily. Third, by freezing singly, or in small containers, a large surface is exposed per pound of material handled, and in addition, the heat to be removed from the center has only a short distance to travel in a material having a rather poor conductance.

Resistance to the escape of heat from the surface of the commodity is reduced by the use of high velocities, and by agitated, turbulent flow over the surface. Lower resistances obtain with liquids than with air; thus where practicable, immersion in agitated brine, syrup or alcohol can be used to provide rapid freezing. Good contacts between plate and package, and between the package and its contents are essential.

The temperature of the commodity being fixed during freezing by its freezing range, a large temperature difference can be secured only by having the refrigerating medium at a low temperature. The use of low temperature might be described, however, as the lazy thinker's method of obtaining quick freezing. Every effort should be directed toward exhausting the possibilities of other methods. Low temperature is undesirable because it tends toward overfreezing of the outside layers of the commodity, and toward increased loss by evaporation during freezing. It is also recognized by experienced refrigeration engineers as being an expensive method because it makes compressors operate at reduced capacity, and with higher power and maintenance costs.

The desirability of reducing resistance to heat exchange is illustrated by data from an air-blast asparagus freezing test, shown in Fig. 1. Although the air temperature ranged from –30 deg. to –40 deg. F., the temperature in the space between the waxed carton and the cellophane liner was from 0 to –5 deg. F. until freezing was nearly completed. With better contact between the paraffined wrap, waxed board, liner and asparagus, the resistance within the package would have been less, and freezing could have been completed as rapidly without requiring such a low

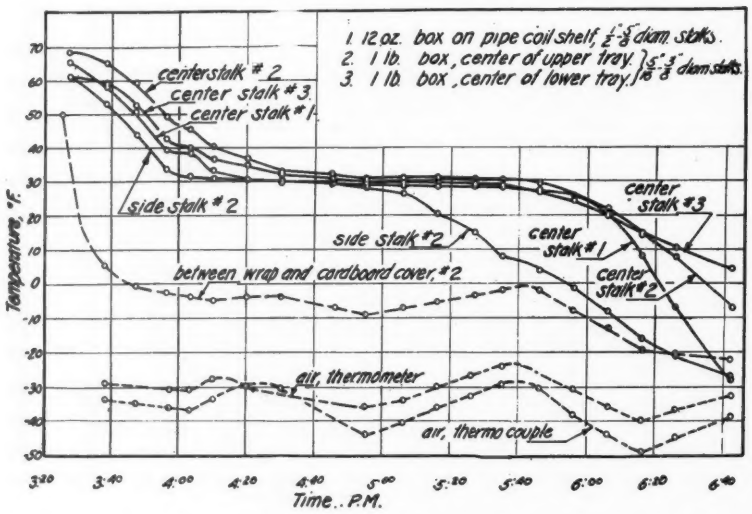

Fig. 1. The desirability of reducing resistance to heat exchange is shown by this chart which shows data obtained in freezing asparagus in the package in an air blast

Excessively Low Temperatures[1]

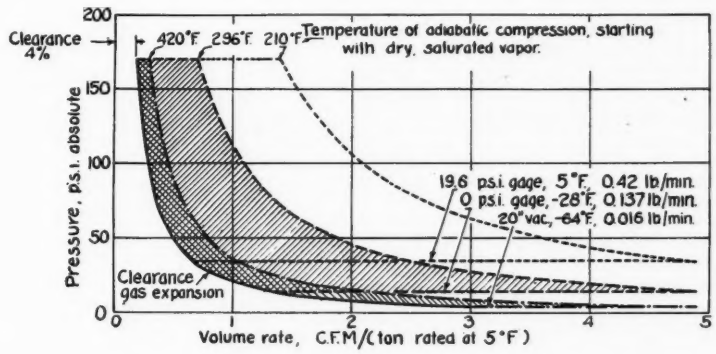

Fig. 2. An idealized indicator diagram depicting the operation of a compressor at three evaporator pressures with a four per cent clearance volume

air temperature. These comments on the operation of this system are made in a spirit, not of criticism, but rather of stimulation toward further improvement. The unit did have the advantage of simplicity and flexibility, and an acceptable product was obtained.

The influence of temperature on compressor capacity and operating cost has been shown by Motz[7] and others,[8] and by the rating tables of manufacturers. The increased interest in the use of low temperature refrigeration which has been provoked by quick freezing would seem to warrant more emphasis on these relationships. The operation of a compressor at three evaporator pressures is shown by the idealized indicator cards of Fig. 2. The pressures of 19.6 psi (pounds per square inch) gage, 0 psi, and 20 in. vacuum correspond to temperatures of 5, –28 deg. and –64 deg. F., respectively. The highest temperature of 5 deg. F. is included, not because of its possible application to freezing fruits and vegetables, but because it is used in defining the standard tonnage rating of a compressor. The capacity of the machine is about proportional to the length of the discharge line at the high pressure, shown as 154.5 psi gage. The principal reason the capacity is low at low pressure is that here the density of the vapor is low; that is, a given volume contains fewer pounds of vapor. Another reason is that the compressor cannot begin to take in new vapor until the pressure in the cylinder has dropped slightly below the suction line pressure. As the piston moves out after completing the compression stroke, the vapor which was left in the clearance space expands and its pressure drops. The lower the suction pressure, the further out the piston must move before the clearance vapor pressure is lower than that in the suction line, and the smaller the volume of new vapor will be. In addition, the weight of vapor in the cylinder at the end of the suction stroke is reduced by the warming effect of the cylinder walls, and by the drop in pressure through the suction valves and ports.

The work required per stroke, represented by the area between the compression and clearance vapor lines on the indicator card, is seen to be much less with low evaporator pressure than with high evaporator pressure. This means that if the compressor is powered in accordance with normal ammonia refrigeration practice at 2 horsepower per nominal ton, the motor will be lightly loaded at high vacuum, and will operate at an inefficient point. Although the work per stroke is small at high vacuum, the work per pound of vapor handled is high because the capacity decreases with lowering of pressure much faster than the work does.

Another difficulty encountered in the compression from low temperatures is the rise in temperature during the compression stroke. The theoretical final temperatures at the end of compression are shown in Fig. 2 to be 210, 296, and 420 deg. F. for the three assumed conditions. In actual practice, the final temperatures will be somewhat higher than these so that some operators feel it necessary to feed some liquid refrigerant from the receiver into the suction line in an attempt to reduce lubrication and maintenance problems. The per cent of liquid feed which is theoretically necessary to keep discharge temperatures below 250 deg. F. is shown in Fig. 3 to range up to 11 per cent at –64 deg. F. In actual practice greater amounts must be used because the droplets of liquid do not readily absorb heat from the vapor being compressed, and do not cool the vapor effectively. Some are left unevaporated in the clearance space at the end of compression. Now as the pressure drops they quickly flash into vapor and tend to keep the pressure in the cylinder higher than it should be, thus reducing the amount of new vapor which can be taken in, and reducing the capacity appreciably lower than that shown in Fig. 3.[9]

At –45 deg. F., the capacity will be only half that at –28 deg. F., and at —60 deg. F., only one-fourth of that at —28 deg. F. The actual capacity of a machine with smaller clearance will not be reduced as much by low temperatures as these data indicate, except with a large fraction of liquid fed into the suction line.

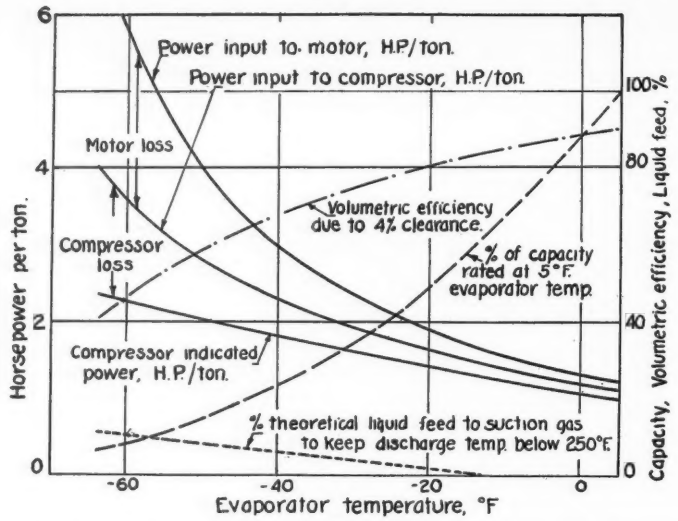

Fig. 3. The power per ton required in the compressor cylinder increases as the evaporator pressure is lowered

The power per ton required in the compressor cylinder increases as the evaporating pressure is lowered, as shown in Fig. 3. Power input to the compressor shaft is greater than this because of friction losses, which comprise a larger and larger fraction as the load is reduced. In addition, the motor efficiency drops off at light loads, so that the effect on the power supplied to the motor is even more pronounced. In Fig. 3 the power supplied to the motor is expressed as horsepower per ton, rather than the more usual kilowatts per ton, in order that the motor losses may be more clearly indicated. Of course, if the compressor is powered specifically for low operating pressures, a smaller motor would be installed, and would operate more nearly at its peak efficiency.

In the design of a complete new plant, these problems of low compressor capacity and high horsepower per ton are usually appreciated and allowed for. In adding a food freezing unit to an existing plant they have sometimes been slighted. The reduction in capacity which has been described can be minimized by multistaging, or by installation of a booster compressor. Some saving in power can be realized by staging and by booster operation.

In brief then, the desirable system is one which will provide rapid freezing without excessively low temperatures. This will tend toward better products and lower costs.

Bibliography

[1]A Contribution to the Round Table on Frozen Food Production and handling, 30th Annual Convention, NAPRE—Los Angeles, California, Nov. 14-17, 1939.

[2]Associate Professor of Agricultural Engineering and Assoc. Agricultural Engineer in the Experiment Station, University of California, Davis, Calif.

[3]Birdseye, C. "Quick Freezing of Perishable Foods." Ice and Refrigeration, v. 78, pp. 547-552. 1930.

[4]Diehl, H. C., E. H. Wiegand, and J. A. Berry. "Preservation of Fruits and Vegetables by Freezing in the Pacific Northwest." U.S.D.A. Mimeo. MC-53. April, 1939.

[5]Woodroof, J. G. "Microscopic Studies of Frozen Fruits and Vegetables." Georgia Experiment Station Bulletin 201. 1938.

[6]Joslyn, M. A. "Preservation of Fruits and Vegetables by Freezing Storage." California Agricultural Extension Circular 320. 1930

[7]Motz, W. H. "Principles of Refrigeration." Edition 3. Nickerson and Collins. 1932.

[8]Macintire, H. J. "Handbook of Mechanical Refrigeration." John Wiley & Sons. 1928.

[9]"Refrigerating Data Book," Ed. 3. American Society of Refrigeration Engineers. 1936.

What Does An Oil Do?

By Earl Cooper

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WHILE THE LONG cherished idea that the chief function of a lubricating oil is to reduce friction is still good, it has been considerably augmented during the past decade. Higher compression, closer fitted, faster turning internal combustion engines of today require oils to perform additional duties—duties not conceived in 1925.

Lubrication experts today recognize four very important functions an oil must perform in the crankcase. Failure of the oil to perform any one of these jobs can, and invariably does, lead to impaired motor performance and costly repair bills. These four functions are briefly:

An oil must lubricate. This function is obvious and clearly understood in a non-technical way by the average consumer. Lubricating oil forms a protective film between every moving part in the engine, insulating against metal to metal contact which, if allowed to occur, would ruin a motor after only a few hundred revolutions.

An oil must cool. This function is very important and only during the past few years has it been widely recognized. Modern high-compression engines generate tremendous heat which must be dissipated. Since the water cooling system only carries off heat from the motor block, lubricating oil must circulate rapidly enough to cool bearing surfaces and keep them below the danger point. This is one reason why we now recommend lighter oils. They circulate faster and therefore stay cooler, actually losing less viscosity at operating temperatures than a heavy, sluggish oil.

An oil must seal. High compression engines would retain no advantage at all, if the pressure of combustion were allowed to leak past the pistons. Piston rings and a lubricating oil of proper viscosity are the only factors that prevent this. The oil must form a seal between cylinder wall and piston rings. Too thin an oil will fail to hold, too thick an oil will have difficulty getting to this crucial point until it is warmed up.

An oil must clean. It must actually wash off minute particles of carbon and other contaminants from close fitting surfaces. To do this it must be clean itself. An oil that forms carbon and sludge rapidly cannot possibly do this cleaning job.

REFRIGERATING ENGINEER

Part IV. You learn that a ship does not have two captains, nor a car two drivers at the steering wheel. On your first day all alone in the plant you get some experience about cans which may some day keep you from getting canned and in your spare time learn a few things about the system as a whole. The pipe lines begin to mean something

By GEORGE HOLMAN

YOU ARE NOW a refrigerating engineer, for you can feel it in your bones. You can especially feel it in your bones on the morning after your first day at the Wholesome Ice Plant and Food Market. You are stiff from the unusual labor of hoisting ice cans but you are ready for another day.

You have slept soundly and you have slept late, with no dreams of June Frost to interfere with your recuperation of energy. In fact, you do not even think of June Frost until you reach for your hat to go to work. But when you do think of her, you at once enter into a debate with yourself as to whether or not you should go out of your way and past Frosty's house for a possible glimpse of that brat of a daughter of his. You are late, however, so decide to go straight to the plant and detour past Frosty's on your way home after quitting time.

Frosty is already at the Wholesome when you get there. He is talking to Andy and to a big man in a white bibbed apron. "This is Butch Fleischer," Frosty introduces you to the man in the apron. "He manages the Market. Butch, this is Abel Workman, the new engineer. Give Abel time, Butch, and he'll take care of your complaints about the storage."

Butch says, "Howdy, Poy!" and grabs your hand like it is that cleaver he mislaid some time back and has just now found. "Maype now vee gedt dings straightened oudt vonce yedt. It iss our coolers are too high or too low mit der damperature, or der iss a leak mit der pneumonia or someding all der dime. It iss effer zince der Wholesome open for pizness I haff peen here. Undt neffer haff der damperatures peen right. It iss till I'm plue in der vase I have zet dem dermostadts undt dermoexpulsion valfs. Undt zo mit Derry Ledderpee, bevor he vas kildt. Undt neffer didt vee gedt der blace zo to operade like as it ought to, yet. It is dree different enshineer vot come vrom der comp'ny undt zedt oop dem dermostadts undt dermoexpulsion valfs. Undt vhen dey lefft, it iss nicht a week past till a cooler iss too varm or too cold, or Derry vould haff vloods in his machines."

Frosty says, "Well, Abel, here, is in charge of the refrigeration systems of this plant now. I want that understood. If there is anything to be changed about these systems, Abel will make the changes. Right now he probably doesn't know a thermostat from a thermos bottle. But he is interested and wants to learn. I would rather have a man interested in his occupation who knows little than to have a man without interest who knows a whole lot. I know Abel well enough to know that he won't have to learn the same lesson twice."

"You should not have monkeyed with those valves and thermostats, even if Terry told you to do so." Frosty reprimands Butch. "That was his job. There are no two men in the country who can manage just one plant, big or little, although one man may manage a pretty big one. You never hear of a ship going to sea with two captains. I am sure that Abel can manage this plant, once he gets next to things. And I'm just as sure that he can't manage it well if he allows you or me or one of those company engineers a hundred or a thousand miles away try to make his adjustments for him. He can manage this plant efficiently by setting the valves and bearings and switches the way he wants them. And I know he's got sense enough to ask for advice before taking undue risks. I'm gambling on him anyway. And I'm holding him responsible for anything that goes wrong. If something happens that wasn't his fault, he will have to prove to me that it wasn't."

All Alone

Butch goes back to the Market. To you Frosty says: "I'll have to leave you by yourself today, Abel. You can take over the plant right now. We won't be able to get the ice making compressor started before tomorrow. You can let these other two heat squeezers kick on and off automatic. The smaller one here does the sharp freezing over in the Market. It has only one room to keep cold. The other heat squeezer there is a puzzle. It's wired in parallel on fourteen coolers, the chill room and the ice storage. It's going now, whether on one cooler or a dozen the Lord only knows. By getting warm any one of the rooms may start it going. But every last one of them must be cold before it will stop."

"I haven't ordered any new cans," Frosty goes on. "They would be a week getting here. And I don't like the looks of that brine well enough to put new cans into it. Besides, their cost would eat a big hole in this season's profits. I'm having 150 or more old cans from the Aurora sent down, together with a firepot, soldering irons, solder and some pieces of scrap sheet metal. It's up to you to make these cans water tight enough to last out the summer, if you can. I'll send some extras. Try to get as many patched up today as you can. We want to get the ice maker to going tomorrow. I'm leaving you now. If anything goes wrong, remember that it is better to do nothing at all than to do the wrong thing. There are always more ways to do a thing wrong than there are to do it right, no matter what that thing is."

Frosty and Andy go out the door and you are left with the refrigerating equipment of an ice plant and a number of storage rooms on your hands. You walk slowly about the machine room and stare at the

pressure gages and at the odd-looking gray head on one of the twin cylinders of the idle ice making compressor. You read the tags on the motors, a 100 hp. one on the ice maker, a 40 hp. on the cooling room compressor, a 15 hp. on the sharp freezing compressor, a 20 hp. on the centrifugal water pump, a 5 hp. on the blower in the corner and a 5 hp. on the agitator circulating the brine in the tank. You read the tag, 500 gal. per minute, 60 ft. head on the pump, and vaguely wonder why the red figures on the pressure gages do not increase uniformly with the black ones. You listen to the pulsations of the cooling room compressor, or heat squeezer, as Frosty called it. It is the only one now operating. You listen to the humming of the gadgets on the switchboard and to the water running into a drain situated beneath a vertical cylindrical vessel which your book on refrigeration calls a shell-and-tube condenser.

A sudden squeak and whine, something slamming on the switchboard, and you almost jump out from around your breakfast. You look about, and find that the sharp freezing compressor has started. At first it turns slowly. Then there is a click on the switchboard, and the combination pulley and flywheel of the compressor, driven by a half dozen V-belts from the pulley of the motor, whines and picks up speed. A second click, and again the motor whines and pulls away at the compressor. A third click, a third objection from the motor, and the unit is up to top speed. Its pulsations now join those of the cooling room compressor.

How Ice Is Made Clear

Pretty soon you again go into the tank room and up the steps onto the wooden lids covering the tank. You lift a lid, and discover two cans filled with water beneath it. A header pipe lies across the midsections of the cans, and small tubes run from it down into each can. There are other headers leaning against the tank room wall. Some of them have tubes already attached. By lifting more lids, you trace the header to one side of the tank. There it joins a still larger pipe. You trace this larger pipe back into the machine room, and find that it is connected to the blower in the corner. So-ho. That is the way the ice is made clear by agitating the water with air during freezing.

You go back to the tank room. Lifting more lids and looking under them, you at last come to the point where the cans run out. The brine is yellowish brown, and seems pretty low, a good foot below the wood framework over the tank. You replace the lids and look at a dial thermometer on the wall. Forty-two degrees. An odd-looking copper wire runs from the thermometer down into the brine tank.

You survey the tank room further. The tank is about 50 ft. long and 16 or so wide. The agitator sets at one corner of the tank. On one wall hangs two rubber hoses of about 2 in. outside diameter each. Near the hoses and setting on the duckboard floor that runs across one end and along one side of the tank are two vessels. The alum pot and pipe connections tell you that the two vessels are water filters.

At the end of the room are two cylindrical vessels which you cannot identify, but you start tracing pipe lines and after a while you begin to understand them. Soon you find that you have traced through two of the three systems. This is satisfying. About this time, however, one of Frosty's drivers backs up to the curb with a truck load of ice cans. You sign for the cans, and the driver helps you carry them through the machine room and up the steps into the tank room. Thirty cans, all of them so rusty that you almost get the lockjaw from just looking at them. Some of them have patches on them, some have solder spots, and some both. And you must repair them.

You are pleasantly surprised to find that the first can you test is watertight. But the second one isn't. Although it is broad daylight and electricity costs money, you turn on the tank room lights, lay the can on an empty calcium chloride drum and stick your head in the can. One, two, three, yes, the light comes in through four pin holes. Ah, yes. Another one. Five places to solder.

Between helping the truck driver unload a second and third load of cans and watching the two operating compressors, you repair 18 cans, and find that 15 is enough to make one row across the tank. To get the repaired cans out of the way in the narrow confines of the tank room, you decide to fill the water-tight ones and set them into the brine.

This is a new experience. You set a can in the dump, find and open a gate valve in the cold water line leading into the measuring can over the dump and await developments. The measuring tank fills and begins to overflow. You discover that you have a lever before you to shift, and shift it. The can fills to within 6 in. of the top, and the measuring tank turns dry. Jerking the lever back and forth a couple of times, and the water starts again. You finish filling the can. You fill it until water runs out the holes in the sides into which you must hook the spring-loaded adjustable bar Frosty called a can lifter. You weave back among the cans you and the truck driver have carried up onto the tank lids, and get the hoist. You get back to the dump with the hoist, hook the lifter bar into the holes in the can, and then discover that you must move two or three dozen empty cans before you can roll the hoist back and lower the full can into the brine.

You Learn About Filling Cans

Altogether, Frosty sends you 180 cans. Of this number you find a few good ones, and repair enough of the others to have 58 filled cans in the brine by the time Allen comes in to relieve you at a quarter till three. Allen takes over your worries about the machines, and offers to help you with the cans if you wish to work overtime. You take him up on the offer. But when Allen sees that you fill a can until water runs out the holes for the lifter bar, he says, "Whoa, there! By the time that freezes you'll need sideboards on it."

"I filled the other 58 clear up," you innocently admit.

Allen laughs, "A job for the core pump! I'll pump them down to level after you leave. Always allow about 40 in. of water for a 44 in. cake of ice. There are floats up there in that measuring tank. They are supposed to cut off the water just right for a 300 lb. cake. They don't always do it, though."

By 6:30 you have repaired 90 cans, a total for the day, while Allen has filled the last 32 and placed them in the tank. The brine level is still low, but Allen says that it is high enough for the agitator to circulate without drawing in too much air.

You are too tired to make your intended sashay around by Frosty's house. You go straight home instead, and eat a big supper. While debating with yourself as to whether you should visit the Coldfax home or call June by telephone, you fall asleep on the davenette.

A Letter From The Secretary of The Navy

DEPT. OF THE NAVY
Office of the Secretary,
Washington, D. C.
April 4, 1941

R. E. Turner,
Editor, Power Plant Engineering.
My dear Mr. Turner:

In your letter of January 9, 1941, you ask for a brief message from me which you could place before your readers, composed of professional and operating engineers in power plants throughout the country.

Practically all Navy Yards and Naval Stations have their own power plants, which differ from central station plants in that the latter produce and sell to their customers but one kind of power, and that is electricity. The Navy plants, however, furnish electrical energy, steam for heating of buildings and for process work, compressed air at various pressures up to 3500 lb. per sq. in., fresh water at pressures up to 2500 lb. per sq. in., and salt water for fire protection and flushing purposes.

Power plants for the shore establishments of the Navy may be considered as the heart of the Yards and Stations, since these activities could not function without an adequate and reliable supply of power; in fact, I might go as far as to say that, without such power, the fighting ships of the Navy could not operate successfully since they are absolutely dependent upon the Navy Yards for maintenance, supplies and repairs. Power plants, therefore, are given a prominent part in the organization which their importance warrants. Power supply must, under present conditions, be absolutely reliable and ample to meet the demands. It should also be produced at the lowest cost, not necessarily the minimum cost for a particular service, but the lowest overall cost for all services, since a decrease in the cost of one form of power may at the same time result in an increase in the power cost of some other service supplied from the plant.

The defense program, of course, is increasing the power demands of our establishments to an extent, and at a rate, which makes it difficult to provide power producing facilities in time to meet these demands. It is difficult to obtain delivery of equipment within the time required, even with the assistance of Government priority orders, and it appears that conditions in this respect may become worse with the constantly increasing demands of industry and the Government.

In all important Naval establishments, it is our policy to provide an interconnection with the public utility company in the vicinity, which will provide either emergency or auxiliary power in the event of accident or casualty to our own generating apparatus. In some cases this outside source of power is used only for emergency, but in others we operate in parallel with the outside system, depending on the relative costs. In general, however, we find that the public utility companies cannot offer rates for electric energy comparable with the low combined rates of generated steam and electric power in the Navy's more modern power plants when full advantage is made of the use of extracted steam from its prime movers to supply process demands and building heating.

At many of our outlying Stations, especially where auxiliary sources of power are not available, we feel that the importance of maintaining a constant and reliable power supply, even under extremely adverse emergency conditions, well warrants the increased expenditure we are making for the bombproofing of our power plants, as well as communication centers and certain other essential activities.

I know that many of the operating engineers throughout the country, especially those in industrial plants engaged on defense orders, are confronted with problems which are similar to ours and through the medium of your excellent publication, I give them this brief message in furtherance of the thought that we must all co-operate to the fullest extent in advancing and expediting our great national defense program.

Sincerely yours,
FRANK KNOX

At the throttle of the Wyoming

OUTSIDE BOILERS

Second outdoor boiler unit installed in Shell's Wood River (Ill.) Refinery after experience dating back to 1935 with a similar unit. A duplicate of the second unit will be installed this year

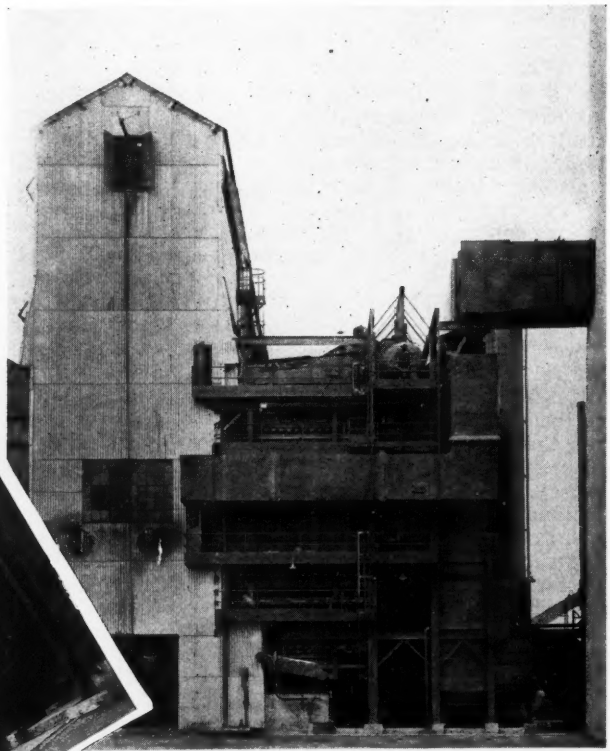
WHILE OUTDOOR and semi-outdoor steam plant construction is sufficiently common so that a job of this kind may no longer be considered unique, it is still sufficiently novel to cause widespread attention. Of recent years, building costs as a proportion of the total plant costs have declined so that complete outdoor construction is no longer the crying need that it was a decade ago.

Nevertheless outdoor construction is forging quietly but steadily ahead. Perhaps one of the most significant recent installations is the unit installed last year in the Shell Oil Co. Wood River (Ill.) refinery, Boiler House No. 2. This was made after experience with an outdoor boiler unit in process operation since 1935 and, of course, with extended experience with other refinery equipment, a large part of which is of outdoor or semi-outdoor construction.

The new unit was an extension of a plant in which 8 boilers were already installed and is shown from the back and side by Fig. 1 and 2. The corrugated asbestos covered central section of the existing plant and the coal bunker was extended to serve the new boiler. This central extension, of which the front of the boiler casing serves as one wall, is the only enclosed space. Pulverizer feeders and the boiler control panel are located on the operating floor as shown by Fig. 5 and the pulverizers are immediately below on the ground floor.

The boiler itself, air heater, dust collector and induced draft fan are located outside as shown by Fig. 1, but the forced draft fan was for convenience located on the operating floor of the old plant. The forced draft duct across to the new unit can be seen in Fig. 1 above the induced draft fan. Space is available in the foreground of Fig. 1 for several more units, both alongside the new Boiler No. 9 and on the opposite side of the firing aisle.

A cross section of the new boiler is shown by Fig. 5. It is a Riley RP unit, rated at 125,000 lb. per hr. of steam (continuous) and although now operated at 175 lb. pressure 575 deg. F., is



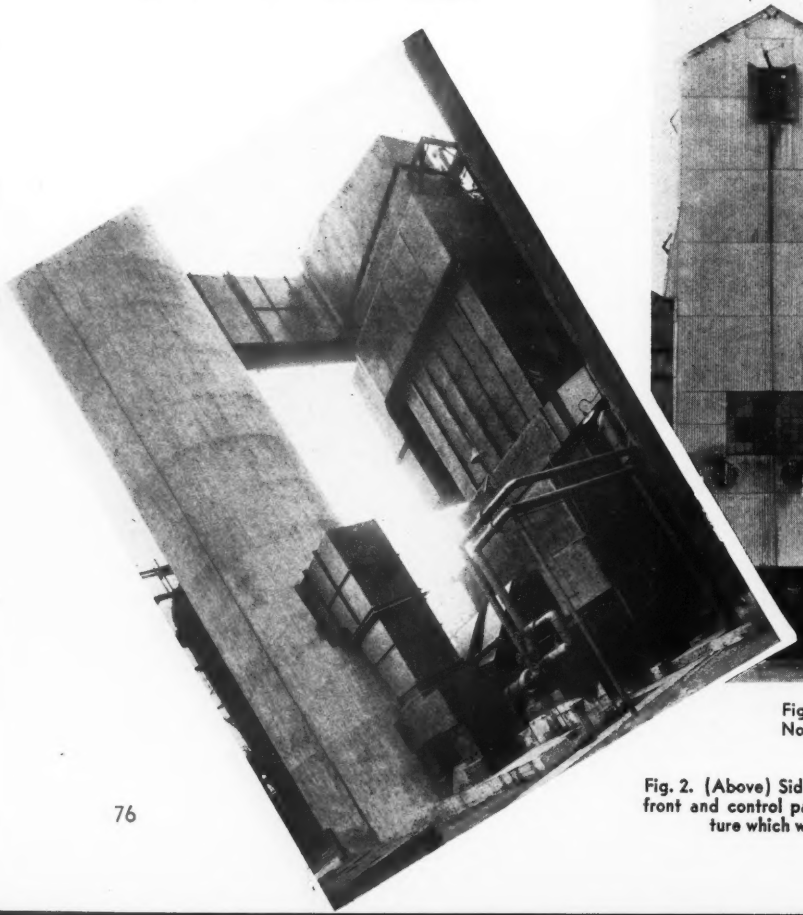
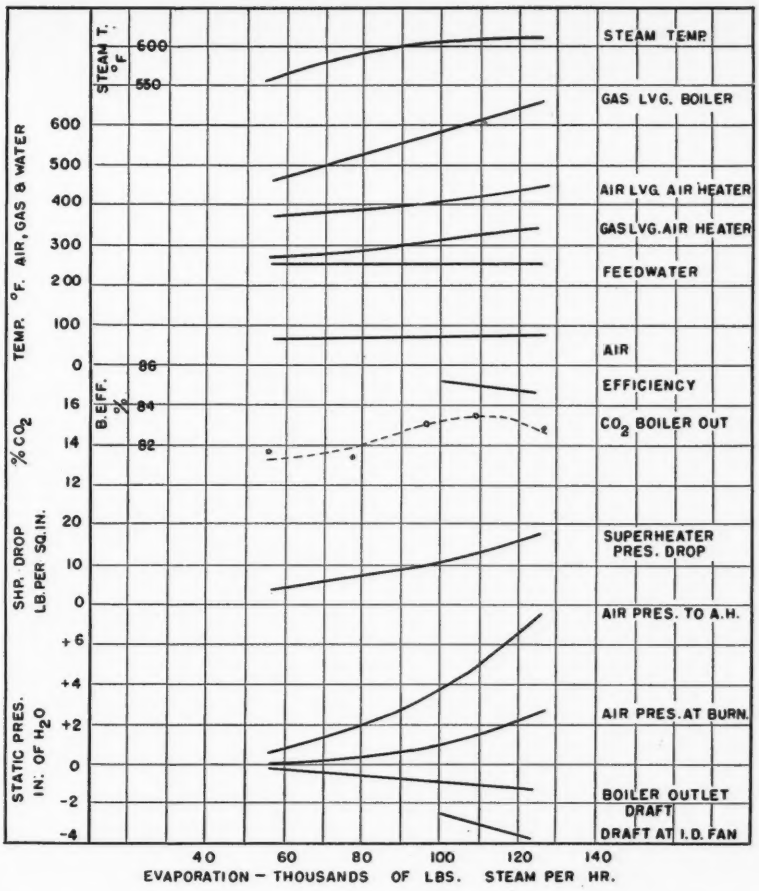


Fig. 1. (Left) Rear view of unit at the end of boiler house No. 2. The induced draft fan, with turbine drive, is at ground level just to the right of the stack

Fig. 2. (Above) Side view of the outdoor unit. The feeder, pulverizer, boiler front and control panel are enclosed by a corrugated asbestos superstructure which was formed by extending the existing boiler aisle

Fig. 4. Boiler test made shortly after starting up the unit and when firing Illinois coal. Steam pressure 175 lb. per sq. in.



designed for operation at 650 lb., 750 deg. F. should that prove advantageous later in connection with power generation. The unit has 10,100 sq. ft. of convection boiler heating surface; 4500 sq. ft. of water wall surface and a 15,000 sq. ft. tubular airheater. After leaving the airheater and before entering the induced draft fan, the gases pass through a Bubar dust collector.

The furnace has a volume of 8150 cu. ft., giving a heat release of about 22,300 B.t.u. per cu. ft. per hr. It is fired by two Riley coal burners accompanied by combination oil and gas burner. The coal is supplied from a double Riley Attrita pulverizer located on the ground floor and driven by a 250 hp., 900 r.p.m. Allis-Chalmers motor. While petroleum coke, coal, oil and gas are all burned in Boiler House No. 2, it is expected that only coal and oil will be used in the new unit.

Inasmuch as reliability is a major factor in a refinery, the stack was designed to give sufficient natural draft to operate the unit at 65 percent rated capacity with the gases bypassing the air heater. The gas bypass is shown in Fig. 5 above the air heater.

All exposed lines are traced by 1 in. steam lines installed next to the pipe under the insulation. This is to prevent freezing, for low temperatures in the St. Louis district are not uncommon, in fact when the unit was first placed on the line last winter the temperature was 15 deg. F. below zero. The steam lines are supplied with 175 lb. steam at all times and are drained by traps so that there is no possibility of their filling with condensate and freezing.

Other details of the boiler itself are shown by the cross section Fig. 5. Ash is handled by an Allen-Sherman-Hoff sluice sys-

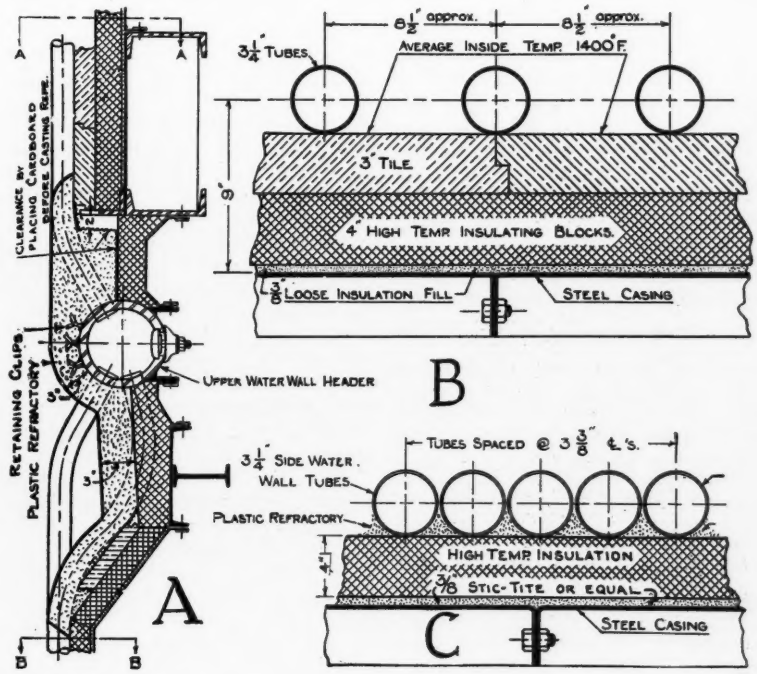


Fig. 3. Typical details of the wall and steel-clad insulated casing. A, vertical section at the top side wall header. B, wall section above the furnace (Section A-A of A). Based on an inside wall temperature of 1400 deg. F., and an outside casing temperature of 120 deg. F., the heat loss is estimated at about 190 B.t.u. per sq. ft. per hr. for this section. C, furnace wall section (B-B of A). Due to the screening effect of the tubes, the heat loss through this section is smaller than in B. It is estimated at 62 B.t.u. per sq. ft. with an outside casing temperature of 90 deg. F. Both heat loss figures are calculated for 70 deg. F. outside temperature and an air velocity of 10 m.p.h.

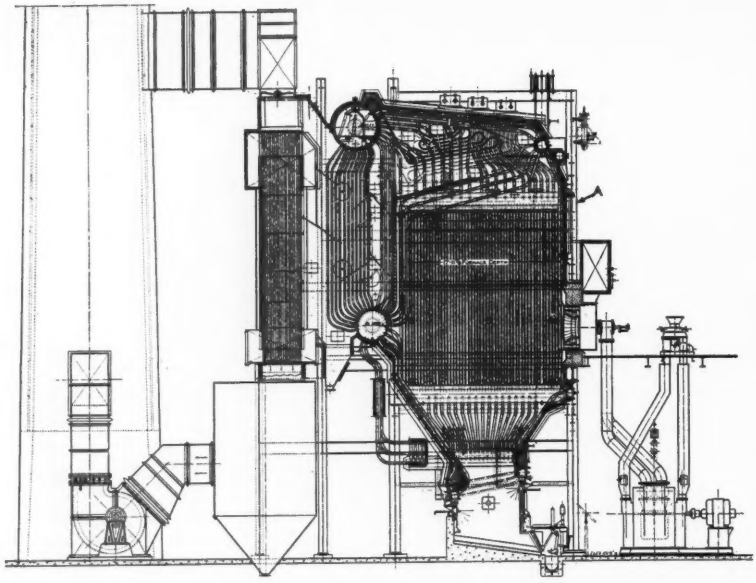


Fig. 5. Cross section of the complete boiler unit. Natural draft is sufficient to carry approximately 65 percent load on the boiler with the gases bypassed around the air heater and dust collector to the stack. Everything to the left of Col. A is outdoors

tem. Accessories include: a Republic automatic control, Consolidated safety valves, Copes feedwater regulator, Yarway blowoff valves, a Diamond Bi-Color gage glass and water column, and Bayer soot blowers, 10 rotating elements supplemented by 3 gun type units in the front wall. Both Clarage forced and induced draft fans are driven by non-condensing steam turbines.

Several details of the wall construction are shown by Fig. 3. The casing of 10 gage steel has been painted with asphaltum paint and the roof, first covered with metal lath, has a ⅜-in. coating of ganister made from ground up firebrick, old asbestos and mixed with Portland cement. This top covering was used to give added protection against corrosion, always a possibility due to the tendency of flyash from the older coal fired boilers, to collect on the flat surfaces.

The Wood River Refinery was started in 1918 and had an initial capacity of 15,000 bbl. a day. Numerous extensions have been made, the latest in 1939-1940 bringing the capacity up to 75,000-80,000 bbl. per day. All electric power is purchased and the plant distribution and control facilities were recently modernized by an installation of G.E. 3 ph., 2300 v. cubicles. Each feeder has two cubicles, connected in parallel so that either can be changed without interrupting service. All busses are insulated against short circuits.

Due to utility facilities in the district and the arrangement of the incoming 33,000 v. lines, there is little possibility of power failure. Nevertheless many of the essential units have dual drives, electric motors being supplemented by steam or gasoline engine emergency drives. This arrangement is also advantageous in reducing power costs by controlling the peak load to reduce the demand charge. Rigorous limitation of peak loads results in a favorable load factor. This is under the direction of a load dispatcher who by means of the telephone arranges for starting and stopping certain machines as load conditions demand.

Compressed air is one of the major refinery services. Some 1000 c.f.m. of 40 lb. air is used in process work and from 4000 to 5000 c.f.m of 100 lb. air for general service. In this latter, tube cleaners are the largest single item although instruments and controls are far from negligible. There are some 1000 of these units in service averaging about 0.5 c.f.m each.

Pumping water is another major service, the general water system use ranging from 40,000 to 60,000 g.p.m., primarily for process coolers and condensers. A large part of this is, of course, cooled in towers and re-used. Make-up from wells, of which about one-half is lime treated, runs about 4000 g.p.m.

Steam requirements in winter run from 650,000 to 800,000 lb. per hr., exclusive of steam produced by boilers which operate as integral parts of refinery units. This steam load is carried primarily by two boiler houses, No. 1 with 11 boilers and a total capacity of 250,000 lb. per hr. and No. 2 with 9 boilers and a total capacity of 625,000 lb. per hr., although there is a small capacity of about 40,000 lb. per hr. from waste heat boilers on operating units.

All pumps and compressors take steam from the 150 lb. system and exhaust to the 15 lb. system which supplies the heating and process load. Low pressure requirements in excess of the exhaust are supplied from the high-pressure system through reducing valves. When heating requirements are low, the supply of exhaust steam is subject to control by changing certain units to motor or gas engine drives.

Total refinery fuel requirements are equivalent to about 2500 t. per day, although a considerable portion of this is not used for steam production. Boiler fuel is coal, petroleum coke, gas, oil and sludge. In the boiler houses, gas and sludge is burned as available, about 300 t. per day of coal and 300 t. of coke are carefully scheduled and oil is used as a cushion.

The 8 older boilers in Boiler House No. 2 (with the new No. 9 outdoor unit described earlier) were originally installed for burning pulverized coal. The furnaces are water cooled and when the shift to petroleum coke was made, some difficulty was experienced because of the low volatile content. After some experimenting, the furnaces were remodeled slightly. In five of the furnaces in which petroleum coke is burned exclusively, the tubes were covered with a refractory strip 10 ft. high about midway of the side and back walls. On the two units which alternate between coal and coke, the refractory was limited to a patch on the back wall.

In the refinery, all electric, steam, compressed air and heating services are handled by the utility department coming directly under the Refinery Chief Engineer, J. F. Goldsberry. E. B. McCormick is utility engineer, and E. J. Laatsch, boiler house foreman.

RESET CONTROLLER FOR SUMP PUMPS

Severe operating conditions demanded specially designed controlling mechanism for handling storm flow at Columbus, Ohio. The governing system described was successfully applied by R. P. Lowe and E. S. Smith

FACED WITH THE problem of maintaining the level of water in a sump within rather narrow limits, R. A. Allton devised for the city of Columbus, Ohio, a pump governing system which has met the requirements for a single controller and a semi-automatic shifting of the controller from one pump to a greater number to take care of storm runoff flows without loss of automatic control. Three problems, however, remained to be solved, these being a regulating device that would: (1) change the discharge of the pumps as gradually as possible to avoid disturbing the flow in the sedimentation basin; (2) keep the sump level as nearly constant as possible in spite of its limited area considering the sharp rate of increase of storm flow; and (3) avoid hunting of the speed of the governed pump and resultant flow and level surges, for the pumps are large and have a high moment of inertia.

It was to solve these problems that R. P. Lowe, of Builders Iron Foundry, and E. S. Smith of C. J. Tagliabue Co., undertook the design of the asymptotic* reset controller described in a paper presented by that title before the American Society of Mechanical Engineers at the annual meeting last December.

The first and second requirements outlined above are opposed and the runoff law was consequently critical in determining the design. The inflow into the sump followed nearly the second power of the duration of the storm and the capacity of the plant would be exceeded within 15 min. with the surplus to a spillway to a river. An asymptotic reset in which the reset speed increased substantially directly with the departure from the set level was indicated by analysis to be required. A simple kinetic design followed the desired law satisfactorily closely.

The third requirement was met by cyclical actuation of the final controlling element when needed and with a short interval between actuations so that such element would stop between actuations.

The controller is required to maintain within plus or minus 4 in. the level in the well from which these pumps take suction by regulating the delivery of the four sewage pumps which supplied the plant so gradually as not to disturb the settling process in the sedimentation tanks into which these pumps discharge.

Difficulty arises from the fact that, during a storm, there is a sharp rise in the rate of inflow into the forebay or suction well depending upon the intensity and distribution of the rainfall. It was required that, under the worst conditions, the controller keep pace with the highly accelerated rate of change and cause the sewage pumps to increase the pumping rate smoothly.

Excessive storm flows beyond the 100,000,000 gal. per day capacity of the sewage treatment works are bypassed through storm standby tanks to the river. A main object of the controller is to keep such bypass flow to a minimum. A bypass valve opens automatically when the maximum plant capacity has been reached.

Asymptotic Reset Controller

It was to solve the problem of the continuously accelerated storm flow while keeping the level

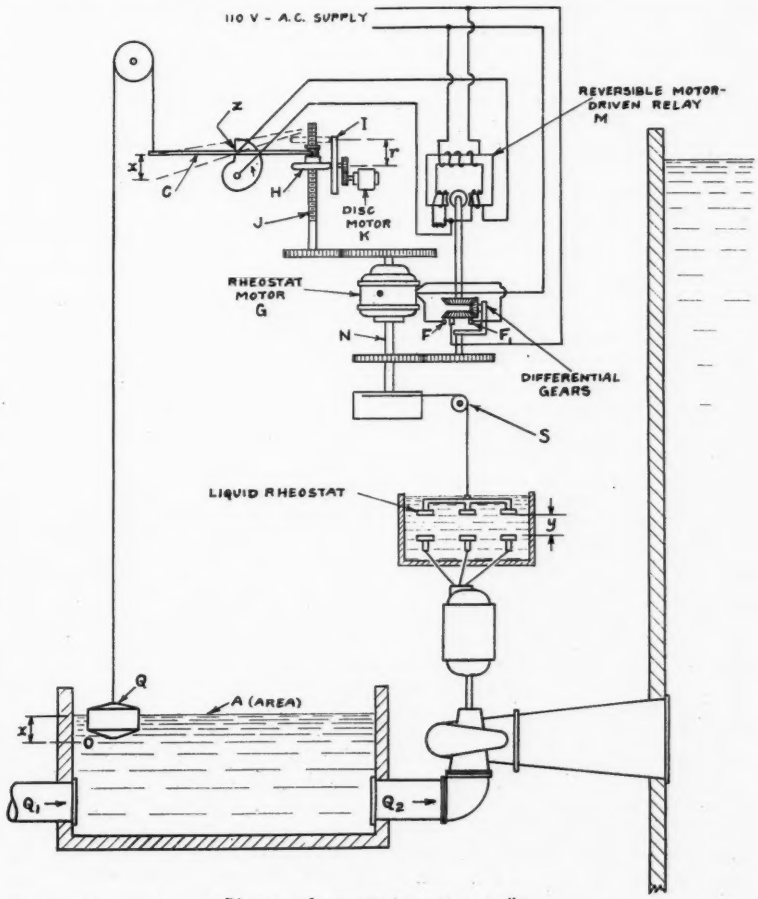


Diagram of asymptotic reset controller

*This term is used by designers to define governing mechanism that function by making adjustments in increments that vary with the change necessary, thus obtaining gradual compliance with the needs without overtravel or hunting. —Editor.

within the specified limits that the controller was designed. A proportional regulator was used for its inherent stability and a reset was added which had a speed proportional to the rate of movement of the rheostat as a working approximation of the rate of change of level, which would be ideal for a constant acceleration of storm flow and its resultant relation of having the storm flow vary with the square of its duration. This is generally like the controller in which the final control element moves in accordance with the departure and rate of departure, which is listed as class 7 in the 1936 A.S.M.E. paper on Automatic Regulators by Mr. Smith.

In the diagram are shown the elements of the asymptotic reset controller used. The float Q moves vertically with the level in the suction well and is connected by a cable to the lefthand end of floating lever C. The right hand end of lever C ends in a yoke carried by roller or friction wheel H which is driven by disc I. K is a small self-starting synchronous motor which drives disc I through an infinitely variable change speed device so that the rotative speed of the disc can be adjusted at will to suit the rate of increase of storm flow, an adjustment which need not be altered once the maximum storm has been compensated for. The floating lever C carries a contact, at an intermediate point, which coacts with a synchronously rotating double-lobe cam to cause a reversible motor-driven relay M to move in one direction or the opposite depending on whether the cam contact has been made or broken, the cam being so shaped that the difference between the periods of the contact in each cycle is proportional to the departure of float Q from a given level, assuming that the right-hand end of lever C remains stationary. The reversing relay M acts as a pilot for the main motor G, a follow-up being used to inhibit hunting.

As long as the cam contact is open, the pilot motor runs steadily in one direction; and when closed, this motor runs steadily in the opposite direction. When the controller is in balance, the cam contact will be open for 50 percent of the cam cycle and closed for the balance of the time, the pilot motor making an equal number of revolutions in each direction in each cycle so that there is no net movement. The oscillations are transmitted through a reducer to a differential gear having a resilient contact-arm which projects between the two contacts F and F_1, and a follow-up driven from the main motor G which, through pulley S vertically moves the rheostat for one of the variable speed pumps. Geared also to main motor G is the screw J which carries the roller H. Any movement of the motor shaft, due to either contact F or F_1 being closed, results in the breaking of the contact and the displacement of wheel H from the center of disc I.

So long as the level being measured by float Q is at the set value, lever C assumes such a position that its contact will engage the rotating cam to operate the motor of relay M to cause an equal oscillation of the arm between F and F_1 in both directions and without touching either, motor G remaining still.

Upon a change of level in the suction well, lever C is moved vertically about its pivot which is the yoke of wheel H. For example, with float Q falling: The lefthand end of lever C is raised so that pilot motor M is energized in each cycle of the rotating cam for a shorter period than its period of de-energization. This causes the resilient contact arm between F and F_1 to move in the direction of and to close the proper contact to cause motor G to wind up the cable separating the plates of the rheostat. Soon after the motor commences operating, the gear on shaft N turns its meshing gear which, through the differential gear, disengages the contact just made, so that a new accumulation of contacts at the rotating cam must be transmitted by the pilot relay M before motor G can again be operated. When motor G thus runs, it also rotates screw J through another pair of gears to displace roller H in a downward direction. This roller or wheel is normally at the center of disc I, but due to a lag in the response of the pump speed to an opening of the liquid rheostat, there is a continued movement of shaft N and a further drawing down of wheel H until lever C is so positioned that the cam contact near or at center again sends out on and off signals of equal duration. As a result, the pilot motor again balances the movement of the weaving arm between contacts F and F_1 so that the arm touches neither. The float Q soon comes to rest because the rheostat has been opened enough to balance the outflow against the inflow, hence to arrest its downward movement.

Concurrently, due to the rotation of disc I, the wheel H on threaded rod J, which is now stationary, is returned upwardly towards the center of the disc. As the wheel moves upwards toward the disc center, the rate of its restoration constantly decreases due to its diminishing distance from the center of the disc. Also, the rate of restoratiton of the desired level is constantly decreasing as the desired level is approached. In other words, both the roller H and the level measured by float Q are restored asymptotically and with the roller pacing the return of the level. During a maximum storm, the wheel H gradually works out further and further on the disc until it nearly reaches its extreme position.

In many cases, including the present one of storm flow, the rate of increase of the input is nearly constant, so that the level will initially increase in second-power relation with time. Wheel H will consequently start to move upwardly in substantially the same relation. However, it will in general asymptotically approach a fixed distance from the center of its driving disc I and maintain a substantially constant departure of the level from its set valuation. In brief, the length of the impulse depends solely upon both the departure and rate of departure of the level and it is this joint relation which in practice determines the choice of the speed of motor K and driving disc I, this speed being chosen to keep wheel H on disc I at the maximum rate of change of the input flow considering the time-relation of the storm flow before the time when the limit is reached.

As the wheel H moves outwardly from the center of disc I, it is rotated at a constantly increasing speed and in a direction to oppose its outward movement which results from the turning of shaft J by motor G. The wheel will be screwed out to a radius such that its rate of turning is high enough so that it settles at a radius substantially corresponding with the departure of the level from its predetermined value. Then the signals are not equal but motor G turns at an average rate which is high enough to balance off the departure.

MIDWEST POWER CONFERENCE

Engineers gather at the Palmer House in Chicago, April 9-10, to discuss power and its relation to the national emergency. Conference held under the sponsorship of Illinois Institute of Technology in co-operation with seven midwest universities and the local sections of seven engineering societies. Total attendance over 1500

Always the perfect toastmaster, J. D. Cunningham (right) president of Republic Flow Meters, pays tribute to the speaker's reputation as a raconteur, at the All Engineers Dinner, but the speaker, Dr. H. N. Davis, president of Stevens Institute, refuses to be swayed from his topic—Priorities in Men, the acute shortage of engineers, emergency training of technicians and the urgent need for a rational administration of the draft to prevent further embarrassment to rapidly expanding defense industries

POWER and engineers as vital factors in National Defense was the underlying theme of the Midwest Power Conference—a theme highlighted by Dr. H. N. Davis, president of Stevens Institute of Technology, at the All Engineers Dinner, April 9. Dr. Davis drew attention to the fact that at present, and he emphasized present, production is more important than combat training and that industry is already facing acute shortages of certain kinds of trained man power. There is an appalling shortage of young engineers, a shortage on which the 12,000 engineering graduates of this June will do little to alleviate.

Of these, close to a third will go directly into the Army or Navy and recent surveys show that the remaining 8000 will not even meet the estimated requirements of the aircraft industry in the New York area alone. Intensive training courses in many areas are already under way to train high school graduates and present industrial employes as engineer apprentices or technicians for some specific job. The bottleneck in this program is the difficulty of finding teaching staffs.

The most urgent need, however, is conservation of the present trained men through a wisely administered system of Priorities in Men. "No engineering trained young men, no matter how young or inexperienced he may be, should be drafted from industry," said Dr. Davis, "and the defense industries should be given almost absolute priority over combat training." He did not advocate blanket class exemption but judicious action of local draft boards within the framework of the present Selective Service Act. False patriotism should not keep the employer or employe from asking for and accepting deferment and the public should be made to understand that this action will contribute materially to the protection of democracy. Public utilities have been among the worst offenders in this pseudo-patriotism.

C. W. Kellogg, president of the E.E.I. and now chief consultant of the Power Unit, O.P.M., gave a brief "off the record" picture of plans to keep the power capacity up to defense requirements. While his remarks cannot be quoted, A. G. Christie of Johns Hopkins University, who is close to the utility industry said: "Barring untimely strikes, sabotage or dislocation of labor in plants building power plant equipment, the electric utilities appear able to meet all demands due to the defense emergency. From a military point of view, hydro-electric power plants are vulnerable while long distance transmission lines are subject to interruptions . . . (and) . . . should be located so they may easily be controlled."

Later Major C. W. Lechy, F.A., elaborated on both of these points. He analyzed the F.P.C. studies by geographical areas to show that in the five regions, power capacity at the end of 1942 would show a margin over the 1941 peak. Barring unforeseen developments, and by the judicious use of transmission lines to take advantage of diversification, no difficulty should be encountered, even without tapping the reserve available from the enforced use of capacity during off peak periods.

He also drew attention to the fact that European combat conditions indicate sabotage is more to be dreaded than bombings. Power stations and substations can be

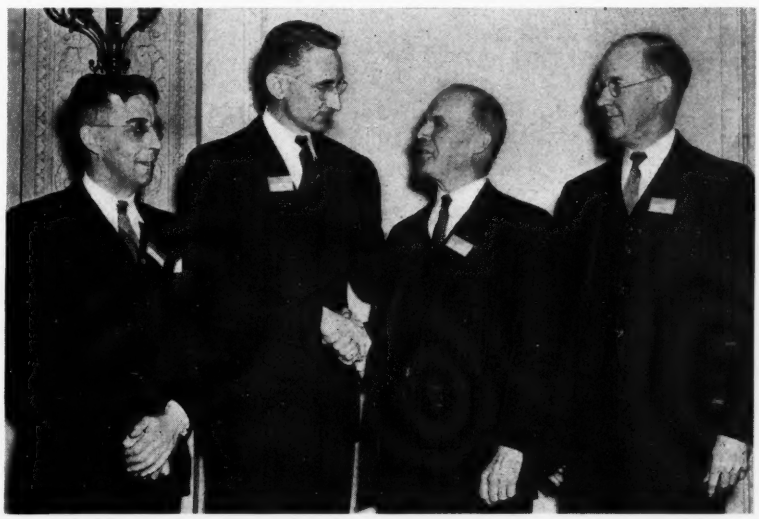


Fig. 2. Formalities before the conference opened. Left to right: H. O. Croft, head of the mechanical engineering department, University of Iowa; L. E. Grinter, dean of the graduate school, Illinois Institute of Technology and conference chairman; C. W. Kellogg, president of the E.E.I. and chief consultant of the power unit, O.P.M.; and A. G. Christie, professor of mechanical engineering, Johns Hopkins University

guarded but transmission lines and distribution systems cannot be effectively protected without prohibitive costs. To minimize this danger, he advocated development of radio equipped repair patrols, portable substations and power plants and sectionalizing distribution systems to minimize outage disturbances and carry essential loads in emergencies.

The part hydro power plays in the national emergency was covered exhaustively by R. B. McWhorter, chief engineer of the F.P.C. In addition to the part already being played by completed plants, others, notably Grand Coulee and the Central Valley project in California, are being rushed to completion ahead of schedule. A large number of others are being started or under consideration by both private and government agencies.

In the various power pools of the nation an essential role is played by transmission lines. On short transmission lines the transmission capacity depends only on heating of the cables and terminal facilities. On longer lines, system stability, the problem of keeping the power service in step with the load is the limiting factor. System instability is analogous to a synchronous motor loaded until it pulls out of step and drops its load.

Among other things this stability depends upon the voltages at each end of the line, the phase relation, line reactance, transients or faults, inertia of the generators, and operating speed of relays and breakers. H. E. Wulfing, system development engineer of Commonwealth Edison, covered this phase of operation with particular reference to the company's calculating board (used to simulate system conditions) and operation of the Chicago system. At Powerton, for instance, where stability considerations are important because of the 150 mi. transmission line, three separate generators feed the Chicago system thrown through lines and are tied together only through the 66 kv. system in Chicago.

Trends in switching equipment and substation assemblies, according to W. J. McLachlan of General Electric, are definitely toward factory assembly and standardization, not only because of lower costs but as a step toward national defense. Maintenance is lower and output can be stepped up quickly. In line with what Major Lechy said, Mr. McLachlan mentioned the development of mobile substations for use during construction.

P. W. Ross (presenting the paper prepared by J. T. Davis, Superintendent, Heating Div., Indianapolis Power & Light Co.) outlined 10 yr. experience of the company on power interchange and the sale of high-pressure steam to industrials. This has developed until in 1940 some 10 percent of the gross revenue of the company was from steam sales, a major portion from 17 industrials using steam at from 20 to 245 lb. pressure. This was not advocated as a solution of the isolated plant problem for all companies.

Industrial plants faced with increasing output of present boiler plants were advised by Prof. R. S. Hawley of the University of Michigan to give increased attention to fuel and fuel handling, effective use of sootblowers and water treatment, and to carefully check traps, steam using equipment and piping for

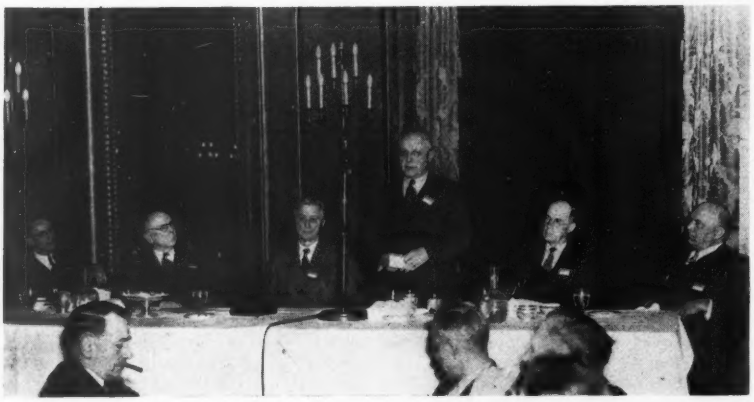


Fig. 3. Over a lamb chop, Alfred Iddles (standing) of Babcock & Wilcox shows scant sympathy for the operator of a high pressure, high temperature boiler who left it unattended to eat lunch. Left to right: S. E. Winston, Illinois Institute and conference director; R. E. Turner, Editor, Power Plant Engineering; L. M. Ellison, president Ellison Draft Gage Co. and local chairman A.S.M.E.; Alfred Iddles; Professor A. G. Christie, and L. W. Wallace, director of engineering and research, Crane Co.

Figs. 4 and 5. Roger B. McWhorter (left), chief engineer of the F.P.C., reviews American hydro development and plans for speeding up construction; Sherman M. Woodward (right), chief water control planning engineer of the T.V.A. tells how they control reservoirs to meet the conflicting needs of flood control, power and navigation all with due regard to fish and mosquitoes. At the same session W. J. Rheigans, test engineer of Allis-Chalmers, told of the design and installation of the 48,000 hp., 24.3 ft. dia. units at Pickwick Landing

leaks. Closely related to this were the recommendations of C. W. Parsons of Republic Flow Meters, to make more effective use of instruments and controls, for higher efficiency and more effective use not only for steam generation but for steam distribution and use in industrial processes.

Four papers of unusual interest, especially to central station engineers, but too long to try to abstract here, were presented. In the first, Modern Steam Turbine Design, C. C. Franck, engineer in charge of central station turbines of Westinghouse, outlined concisely and in considerable detail the designer's problem with particular emphasis on blading, creep, relaxation of bolting material and other metallurgical problems. In the second, G. V. Edmonson, Hydraulic Coupling Div., American Blower Corp., pointed out the advantages and limitations of different variable speed drives for power plant auxiliaries.

F. H. Rosencrants of Combustion Engineering described in considerable detail the 2000 lb., 960 deg. F., 650,000 lb. per hr. Lamont reheat boiler for Montaup Station, the first large forced circulation boiler in this country. All joints are welded, the superheater is in three sections, and three constant speed circulating pumps are used. The furnace is tangentially fired with three coal burners, or two oil burners in each corner. In addition there are four supplementary oil burners in the front wall for boosting the superheat when oil is used as a fuel.

In the fourth of these papers, A. E. Kittridge, Chief Engineer of Cochrane Corp., discussed research work of a fundamental nature on

such factors as temperature, surface tension and viscosity, on the removal of dissolved gases from feedwater, particularly CO_2 and NH_3. He concluded by showing several heater designs for removal of gases to very low values and showed how the designs are varied to meet specific conditions.

As a conclusion to the feedwater session, Prof. Frederick G. Straub, University of Illinois, gave a brief but inclusive review of water treatment problems from the standpoint of scale, corrosion, embrittlement and carryover. Welding has largely eliminated embrittlement difficulties in high pressure units but embrittlement protection is still a problem in low pressure and in the older rivetted boilers.

Corrosion in steam heat systems is, however, still a common complaint due to dissolved CO_2. This forms carbonic acid and in the presence of oxygen active corrosion results. The remedy is removal of the CO_2, neutralization with a volatile alkaline or piping change to keep the pipes well drained or else completely filled with condensate.

PAINT INCREASES HEAT TRANSMISSION

Test results reported before the S.A.E. show that paint has a material influence on cooling efficiency. The tests were made primarily in connection with engine cylinder finishes, but the results are applicable to any service

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Paragon Paint & Varnish Corp.
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WHETHER a coat of enamel will hinder the transfer of heat from a hot engine surface to the surrounding air still appears to be a moot one. A 10 percent improvement obtained by coating an aluminum cylinder with a coat of glossy black enamel has been reported. Again, there are many who reason that such enamels act as insulating films and hence tend to interfere with heat dissipation. Aluminum paint has been recommended for the conflicting conditions of keeping heat in, and for aiding the release of heat from hot metal surfaces. Because of the many doubts and differences of opinion, it appeared that the only valid approach to the answer was an experimental investigation.

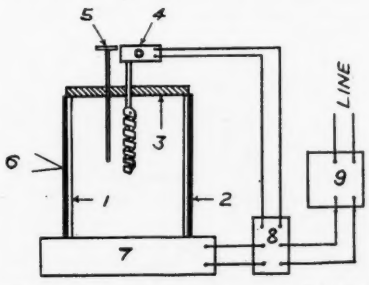

Diagram of Test Apparatus. 1, cylindrical metal shell, 7.5 in. high, 6.5 in. O.D. 2, coating to be tested. 3, asbestos lined cover faced with bright tin foil on inside. 4, bimetallic thermoregulator. 5, dial thermometer. 6. thermocouple. 7, circular, open coil, electric heater. 8, relay controlled by thermoregulator. 9, watt-hour meter

After a good deal of trial and error work, the simple apparatus indicated schematically in the drawing was adopted. A standard size cylindrical metal shell (without top or bottom) is mounted over the open heater and sealed with a cover carrying a dial thermometer and thermoregulator. The thermoregulator is adjusted to maintain a desired nominal internal temperature as measured by the thermometer. When equilibrium was established, the time to dissipate a definite amount of energy (usually about 500 B.t.u.) as measured by the watt-hour meter and a synchronized electric clock is noted. Surface temperatures are measured by means of a pyrometer. Unless otherwise stated, the data refers to metal shells of approximately 30 tinned 26 gage cold-rolled iron can stock; an effective ambient temperature of 70 deg. F. and a nominal internal temperature of 500 deg. F.

By comparing the figures obtained for a coated shell with those obtained for the identical shell before coating, variations due to differences in the base metal units are minimized. However, in attempting to draw practical conclusions, it is important to bear in mind that under actual operating conditions such influences as high air velocities will probably tend to decrease the magnitude of the effects described below so that the figures presented must be regarded as indicative and relative rather than absolute.

The problem is quite complicated and the behavior of a finish seems to depend more on its specific structure and composition than on its superficial appearance. With some vehicles and at certain temperatures, a clear finish may be superior to the same vehicle pigmented with a carbon black; with other vehicles and at other temperatures, the situation may be reversed. Some glossy blacks are more effective than others. Flatting certain gloss-blacks to semi-gloss finishes by the use of finely divided inerts has little effect.

Table I. Cooling efficiencies for a series of enamels based on the same vehicle

Color	Pigment	Cool. Eff.
Clear		1.13
White	Titanium Dioxide	1.12
Red	Iron Oxide	1.09
Green	Chromium Oxide	1.09
Aluminum	Standard Varnish Grade	1.08
Black	Carbon Black	1.07

In order to give a quantitative gage of the effect of a coating material on the cooling characteristics of a metal, there was introduced the term cooling efficiency which is defined as:

$$\frac{\text{Cooling Rate for Coated Surface}}{\text{Cooling Rate for Uncoated Surface}}$$

By way of example, Table I shows the cooling efficiencies for a series of comparable finishes. All the formulations were based on the same high speed baking vehicles and were reduced with toluol to the same consistencies. For this vehicle, the black appears to be the poorest and the clear and white the best. In other work with a similar type of vehicle based on different but closely related resins, it was found that tinting the white with para red improved the cooling efficiency.

Table II. Cooling rate and cooling efficiency as a function of internal temperature

	B.t.u./Sq. Ft./Min.		Cool.	Mid-Height Surface Temp. F	
Deg. F.	Uncoated	Coated	Eff.	Uncoated	Coated
200	2.74	2.97	1.10	133	125
300	5.25	5.90	1.14	186	170
400	8.23	9.25	1.13	236	215
500	11.65	13.00	1.13	286	260

In still other vehicles, different orders of efficiencies for the different colors may be expected. The data does, however, serve to establish clearly the useful fact that certain enamels will improve the cooling characteristics of hot metal surfaces such as air cooled cylinders.

If a high cooling efficiency, as defined above, were all that was required of a good cylinder enamel, it would be a tedious, but straight-forward, task to make up a large number of paints and select the one which had the highest cooling efficiency. However, the problem of designing finishes for cylinders which will not only provide the necessary protection and good appearance, but will also fit nicely into high speed production schedules, involves a considerable number of formulating difficulties.

Table III. Variation of cooling efficiency with number of coats

Coating	Cool. Eff.
1 Coat Enamel	1.13
2 Coats Enamel	1.20
3 Coats Enamel	1.23
4 Coats Enamel	1.24
3/16 in. Layer of Asbestos Paper	0.96

Self-priming cylinder enamels are now available which can be used directly for both priming and finishing coats on all of the aluminum and ferrous alloys of which modern cylinder heads and barrels are constructed. They also form excellent adherent coats over a number of standard primers. These enamels have unusual heat, water, oil and gasoline resistance. Although they are not sensitive to even severe overbaking, they may, nevertheless, be cured rapidly at temperatures of 350 deg. F. and lower. They may be readily brushed, sprayed or dipped and hence are particularly suitable for production line work.

It therefore seemed logical to investigate the cooling efficiency of a number of these cylinder enamels and to select, for further more detailed study, the most promising one: a deep black, high-gloss finish applied in the form of spray coats having average thicknesses of the order of 1 to 2 mils.

Table II presents data on overall cooling rates and corrected efficiencies for a series of nominal internal temperatures. An improvement of the order of 10 percent was observed at all temperatures listed. Application of the enamel appears to result in a lowering of the surface temperature and the magnitude of the difference increases with increasing temperatures. If the coating material functioned on a simple insulator, we would naturally expect the cooling efficiency to drop with increasing coat thicknesses.

Data presented in Table III show a definite improvement in the 500 deg. F. cooling efficiency with increasing numbers of coats so that cooling rate increases in excess of 20 percent may be realized. Since most commercial cylinder finishes are two or three coat jobs, it is interesting to know that at least for this particular enamel, there appears to be a gain rather than a sacrifice in desirable thermal characteristics when a multi-coat system is employed.

It would also seem to indicate that slight pile-up regions due to spray or dip accumulations may not exert an undesirable insulating effect. Again, a certain amount of caution is necessary in attempting to draw broad practical conclusions, since there is at least some evidence that prolonged heat treatment may under certain conditions improve the heat dissipating qualities of the base metal itself. In order to have a simple comparison with a known insulator, a similar metal shell was wrapped with asbestos paper and, as may be seen from Table III, the expected drop in cooling efficiency was obtained.

Table IV. Variation of cooling efficiency with nature of the base metal. Note that this data shows the effect of one coat of enamel relative to the base metal, but does not show the cooling rate of one metal compared to another

Metal	Cool. Eff.
Iron, 30 ga. can stock	1.13
Steel, 20 ga. rolled	1.13
Aluminum, 20 ga. rolled	1.13
Aluminum, sprayed on iron can stock	1.14
Copper, 16 oz. sheet	1.12

It has been reported that the dissipation of heat from bare steel surfaces is about 5 to 10 percent greater than from aluminum and that bronze is inferior to aluminum.

Table V. Cooling rate and cooling efficiency as a function of internal temperature for aluminum sprayed surface[1]. (The third column refers to enamel coating)

I. T.	B.t.u./Sq. Ft./Min.		Cool.
Deg. F.	Uncoated	Coated	Eff.
200	2.97	3.28	1.11
300	5.90	6.60	1.13
400	9.40	10.40	1.12
500	13.21	15.05	1.14

Without accepting or rejecting these findings Table IV gives data for several sheet metal cylinders and an aluminum sprayed steel shell, showing the relative effect of one coat of enamel. Cooling efficiencies appear to be almost independent of the nature of the base metal.

Since sprayed aluminum is frequently used as the sole coating, it was interesting to note the improvement in cooling efficiency obtained by the additional enamel coat. Further data on cooling rates and efficiencies at several temperatures are embodied in Table V[1]. Improvements of the order of 10 percent were obtained throughout the temperature range and again two coats proved to be apparently more effective than one, the second coat for 500 deg. F. internal temperature increasing the cooling efficiency from 1.14 to 1.20.

[1]It is a coincidence that the sprayed (but not enameled) cylinder in Table V shows the same heat loss in B.t.u. as the coated iron shell of Table II. By itself this might indicate that the aluminum spray has the same effect as one coat of enamel and thus be inconsistent with Table IV. This point is further amplified and explained in a letter from Dr. Coler to the editors:

"The sprayed aluminum coating was applied to one of the can stock shells of the type used to secure the data presented in Tables I, II, III and IV and the first item of Table V. The surface was first sandblasted and then sprayed; the resulting finish was fairly rough, whitish and dull. Because of the large number of complex factors upon which the overall cooling rate depends, and because, in general, no two blank shells are exactly alike, the overall cooling rate figures cannot be regarded as absolute for a group of shells.

"However, sufficiently reproduceable results may be obtained with any individual cylinder to consider the cooling efficiencies (which are based on a comparison of a coated cylinder with the same cylinder uncoated) as accurate within the stated precision limits. It is an unfortunate coincidence that the 500 deg. F. figure for the aluminum sprayed shell happened to almost coincide with the corresponding figure of another enameled shell. The coincidence appears to be due to a difference in the two blank shells rather than a similarity in the effects of aluminum spray and enamel finishing. The following supplementary data, based on work with still another shell, may indicate this point more clearly."

The supplemental data showed the following overall cooling rate in B.t.u./sq.ft./min.: blank, 11.45; aluminum sprayed, 11.42; plus one coat of enamel, 12.95; plus two coats of enamel, 13.60. The respective cooling efficiencies relative to the blank shell are, therefore, 1.00, 1.14 and 1.20 which are consistent with cooling efficiencies in Tables II, III and IV.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

COST AND PRODUCTION

THUS FAR in the process of putting the defense program in effect, there have been no power shortages anywhere but it is conceivable that as the manufacturing program expands, power shortages may tend to develop in certain areas. The utilities and private industries are doing everything to anticipate, and thereby prevent, such possible shortages by the construction of new plants and the extension of existing facilities. In most of this work the designers are geared to a philosophy of high efficiency—a rate of 1 lb. of coal per kw-hr. or less. This is admirable from an economic standpoint, of course, but it may not be the most desirable way of looking at things under emergency conditions. It is quite possible that old, probably obsolete, but still usable power plant equipment is in existence which could be impressed into service quickly, even though the resulting power costs would be high compared with those obtainable by the use of modern equipment. It may not be necessary to use such equipment just now but engineers in charge of plants may do well to keep this thought in mind so as to be ready to act when the time comes. At a time when a kilowatt of power becomes a vital factor between the production or non-production of an airplane, tank or destroyer, it is of little consequence whether that kilowatt is produced by the consumption of 1, 3 or even 5 lb. of coal. For a while, at least, it may be necessary to forget the cost of vital things and think of them only in terms of production. A. W. K.

CONTENTS

They Ain't What They Ain't 86

Plant Operation 88
- Spacing Boiler Blowdown Periods From the Rate of Evaporation. By George Blum
- Curbs Under Stoker Ram Boxes Improve Housekeeping. By S. H. Coleman
- Note on Use of 250 Year Calendar.

For The Plant Electrician 90
- Accidental Grounds on Unbalanced Neutral Systems. By Eugene George Key
- Overloading Electrical Circuits. By George L. Radamaker

For The Diesel Operator 91
- Heating Diesel Stations.
- Low Temperatures Affect Diesel Operation.
- Sewage Plant Recovery.
- Expansion Joint from Ordinary Pipe. By W. F. Schaphorst

Questions and Answers 92
- Wants to Set Valves on Chuse Engine.
- We'd Like Help to Get Oil Out of Boiler.
- What Corrodes Most, Hot or Cold Water?
- What Happens When Condensate Pump Fails?

How Would You Do It? 94

Chart for Determining Chemicals Required for Treatment of Water for Various Dissolved Salts by the Lime-Soda Process 100

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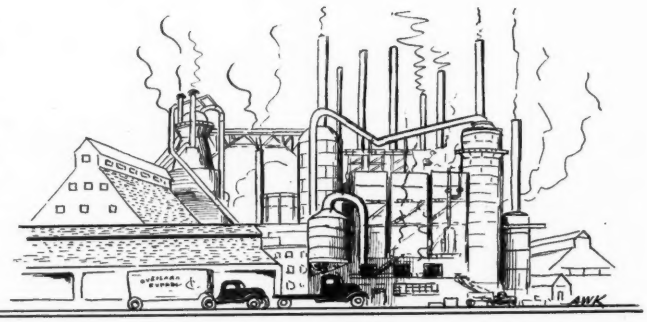
THEY AIN'T WHAT THEY AIN'T

Comments on the article "Engineers and What They Ain't" in the April issue were many and in some instances violent. Many writers liked it, but others exemplified by one of the two letters presented here, insist that engineers ain't what the author of the article said they ain't. Kohlar and Gibbons express themselves here. Other letters will be presented later



WHEN we presented the article about Engineers and What They Ain't in the April issue we knew that we were stirring up trouble, that is, trouble for ourselves. The article was referred to as "dynamite" and we still feel that we were correct in this opinion despite the fact that one correspondent claims it was only exhaust gas. Be that as it may, we started a lot of discussion, much of which is well worth thinking about. One writer took us to task very severely for publishing what he considered a grave libel on the engineering profession and when we read that, we were inclined to feel badly about the matter, but after reading other letters and having "slept" on the situation, so to speak, we still feel that the article by "One who Isn't Either" was worth while.

We know only too well that there is another side to the question. If we had not known that we would not have dared publish this article, because then the case against the engineering profession would indeed be serious. All of us who take pride in being known as engineers are aware of the various facts incorporated both in the original article and in the comments on it presented here, but it sometimes takes discussions of this character to bring these facts home to us in their true relation to each other. Any graduate who has spent a number of years in an engineering college knows that bridges and great dams are not built the way they try to make people believe they are built in the movies, but quite often these young men are inclined to place an undue amount of emphasis on engineering knowledge among the various other attributes necessary for high success in the engineering world.

However, judge for yourself as to whether we committed an indiscretion in presenting the article or whether we added something to sum total of understanding about the matter. While some comments were severely critical others felt that the discussion was of value. Among the latter was George Morley of the American Water Works and Electric Co. Quoting from a letter on other matters in which he refers incidently to the article, "I enjoyed very much reading the article in the April issue entitled Engineers and What They Ain't. This type of article, it seems to me, is valuable to the young engineer in pointing out to him that the way to the top is by hard work alone."

Originally it had been our intention to present the comment on this article in the "Letters and Comments" section but due to its volume and its obvious interest we decided to give it a more prominent place and so we present two of the more important letters we have received here. Others will be presented in subsequent issues.

Thumbs Down Says Kohlar
Editor, P. E. & E.

I was greatly surprised—shocked, would not be too strong a word—when I read in the April issue the article entitled "Engineers and What They Ain't, by One Who Isn't (Period)." Lest there be many more of your readers who share the pessimistic opinions of the anonymous author, allow me to quote from two immortal documents. First, the Bible: But Martha was cumbered about much serving, and came to him and said, "Lord, dost thou not care that my sister hath left me to serve alone? Bid her therefore that she help me." And Jesus answered and said unto her, "Martha, Martha, thou art careful and troubled about many things: but one thing is needful; and Mary hath chosen that good part which shall not be taken away from her." (Luke X, 41-43). Second, the Declaration of Independence: "—that they are endowed by their Creator with certain unalienable rights, that among these are Life, Liberty and the pursuit of Happiness."

For years engineers have gloried in the tradition of being Sons of Martha, we have been happy to bend our backs and sweat and strain that the more fortunate offspring of Mary might sit at the feet of the Master and enjoy "that good part which shall not be taken away." As we grow older, most of us lose in greater or lesser degree our youthful enthusiasm and idealism; but few of us, indeed, surrender completely the enjoyment of that thrill of satisfaction which comes with a job well done, even if the financial recompense appears to be inadequate. I do not think it would be amiss, Mr. Editor, for you to print Kipling's inspiring poem, "Sons of Martha," in this section of your book.[1] Kipling really captures the spirit of self-sacrifice that drives all real engineers ahead. He needn't be building a railroad through a trackless waste; he may be only a minor slip-stick pusher in a large organization —but the spirit is there!

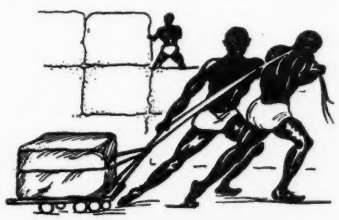
Turning now to the second quotation, it is quite evident that the Declaration guarantees us our Life and our Liberty, but that it requires us *to chase after our own Happiness.* It states in very positive terms that the world does not owe us a living; it owes us only the opportunity to earn a living. The rights and privileges granted with a college degree are the right to get a job and the privilege of enjoying whatever sustenance one may carve out for himself. Some colleges even grant immunities with their degrees. This presupposes that the recipient of the degree has developed his intelligence to the point where he is immune from the petty annoyances that bedevil those who have not had his advantages of education, it does not imply immunity from hard work.

No sane man ever enters the engineering profession—or any other profession, for that matter—with the idea of amassing a fortune and retiring at forty. He enters the profession because he has some innate love for the work, and because it appears to offer the ideal way for him to earn his living. The movies and the fiction pulps will, of course, play up the glamorous side of the profession; but look for a moment at what they have done to all professions. Dr. Kildare can walk

[1]To do that it would be necessary to obtain special permission from the executors of the Kipling estate. The poem can be found in any edition of Kipling's collected works.

down Broadway and tell by the way that the third button on my vest twitches when I move my right foot forward that I am suffering from a rare tropical fever. But for every Dr. Kildare, there are thousands of young doctors prescribing pink pills for measles and yellow pills for belly-ache, and collecting less than $2000 a yr. for all the pain which they relieve and the diseases that they cure. Mr. Tutt can walk calmly out of his law office and go fishing with the Sacred Camels of King Meneluk whenever the fancy moves him; but for every Mr. Tutt there are thousands of struggling young lawyers, poring over mortgages and leases, who are happy if there is a hundred bucks left after the office rent is paid. The majority of young engineers have jobs that will provide at least beer and skittles.

And why, pray, should the young engineering graduate expect to take the world by storm? He has spent 4 yr. or so reading about what other men have learned by patient labor over the course of centuries. His knowledge of Physics, for example, is astounding. He probably would astonish old Sir Isaac, himself—perhaps he knows even more Physics than Ike did. But tell me this: Have you seen any Isaac Newtons walking out of engineering colleges lately? The point that I wish to emphasize is this: Any young engineer who has exceptional talent or ability, who truly stands far above the common herd, must eventually find a high place in the profession. Emerson's crack about mouse-traps is still a good one, and I ain't kidding! With colleges and universities turning out engineering graduates at the rate of some tens of thousands every year, where is the wonder that all of them do not become Goethals, Roeblings, or who-nots? Most of them collect a steady job with a decent living for the rest of their lives, and most of them have no right to ask for more.



The generations of slavery.

The original article extols the pyramids. True, that "gigantic rock piled on gigantic rock" is still to be explained; but so is the spilled blood, the broken bodies, and the generations of slavery of the entire Hebrew race which supplied much of the labor. The pyramids thrust up their rocky pinnacles above the sands of the Egyptian desert, a monument to the egotism of long-dead Pharaohs, and to the lamentations of bereaved mothers; but the Hebrew Passover returns year after year as a reminder to millions of souls that a determined spirit can conquer the lash and the tyranny of a despot, be his name Cheops or Nature. The Pygmy of the Belgian Congo is also mentioned as a master builder. Here are fully matured men building bridges with trees and saplings, and being hailed as unrecognized geniuses! I've got a troop of Boy Scouts who build bridges like that every summer, and do it for fun. Further, any man who can take a "heterogeneous conglomeration" of cables, bars, and girders and build a bridge *is* a genius. "Heterogeneous" means consisting of dissimilar elements, and "conglomeration" means a sticky mass. Start with a mess like that and build a bridge. I dare you.

In your comment on the article, Mr. Editor, you called it dynamite. May I suggest a visit to your oculist? That isn't an explosive, it is merely some exhaust gas which is entirely harmless unless the concentration becomes too great. You also have characterized it as iconoclastic. Well, maybe Mr. Aesop's fox was an iconoclast too; but most of us still think that the grapes are pretty good—that is, those of us who can reach them.

G. Campbell Kohlar

Long Island City, N. Y.

"Blood, Sweat and Tears"

Dear Sir:

I have read with considerable interest, "Engineering and What it Ain't, by One Who Isn't Either," and 'tis indeed a sorry tale, or at any rate, it must be to anyone who is inclined to indulge in self pity, but, life is like that. Churchill told the English that he had nothing to offer but "sweat and blood, and tears" and that is what life generally offers, only, some people forget the tears, glory in the sweat, and don't mind a little blood occasionally. Such men make history, or at any rate they never find life entirely a failure, no matter how hard the going.

The trouble with many of us is, that we don't really know what we want. I never knew a draftsman who didn't think that he wanted to get away from the board, and be an engineer, but, the drafting board is one of the comparatively few places where real engineering is done, and very often a good designing draftsman earns more than an engineer, and does more real engineering too, at any rate he often has to know more. I speak from personal experience in both capacities, so it isn't the slightest use telling me it isn't true.

It is surprising how many engineers don't have to do much real engineering, even the so called consulting engineer is generally engaged in spending his client's money to best advantage, and not in designing. If anyone thinks that he can tell the large manufacturing companies how to design their equipment, he had better wake up, and stop dreaming, and when they tell him how it should be installed and operated, he had better listen carefully, "or else."

I remember, much to my surprise, hearing the executive vice-president of a large public utility, tell a group of engineers, with evident sincerity, that he was not an engineer, and this, in spite of the fact that he was an engineering graduate, and probably had had as much engineering experience as most of his hearers, but his present financial and executive responsibilities made it impossible for him to keep pace with engineering developments.

Too many of us want to hold big business or executive positions, but, we forget that that is quite different from being a good engineer, although it is really surprising how many engineers do become successful businessmen, but, the point is, that they don't do it simply by being engineers, they have to be something else as well.

Herbert Hoover became president of the United States, and prominent in such widely different fields, that many of us have forgotten that, at one time, he was a highly successful engineer, and made a lot of money at it too, but, perhaps that was because he was something more than an engineer, even then.

The fact of the matter is, that if we want a thing, we must go after that thing, and not something else. We complain that the president of an engineering or manufacturing concern, so often comes up from the sales or financial side of the organization, but that is because such positions call for trained business and financial men, and if you want that kind of position, you have got to get the training, even though you are an engineer.

The other fellow's field always looks greener than our own. Some lawyers make big fortunes, but only the other night, I heard it stated on the radio, that the average earnings of lawyers throughout the country, is $2,000 a year, and how many young lawyers who have been called to the bar, never get a chance to practice at all?

As a matter of fact, in many large concerns, the engineers are rather better paid than the average employe in other departments. Of course, most of them don't earn as much as a union electrician, who around New York, gets $2.00 an hr., and time and a half for overtime, but then, a great many of them don't know as much about their business, or at any rate, they don't do as much.

The labor unions are, at least, realistic, they know what they want, and they do something quite definite about it. I do not say that engineers should join labor unions, but I do say that they should not be too proud to fight, and should at least be as practical as a temperamental prima donna, who often makes the rest of us look like shrinking violets, when it comes to deciding what she wants, and getting it, even if she has to join a union.

James O. G. Gibbons

Bloomfield, N. J.

PLANT OPERATION

Spacing Boiler Blowdown Periods From the Rate of Evaporation

By George Blum

ALL NATURAL WATERS contain solid substances either in solution or in mechanical suspension. To such waters as are used in steam generating equipment, other solid substances such as alum or one or more of various alkaline compounds, are usually added, the alum as a coagulant in the filtration from the water of substances in suspension in it, and the alkaline compounds to neutralize or remove scale or sludge forming substances in solution. Upon evaporation of the water in the boilers the concentrated solution or mixture remaining, is usually removed by the familiar procedure of blowdown. Reduced to its clearest definition this procedure is simply the blowing out of the boilers of a part of the concentrated solution and the dilution with make-up water of the remainder to a safe level below the minimum density at which the dissolved or suspended solids precipitate out to form sludge or scale, or cause the water to foam.

Except in plants using very little make-up water, having make-up water containing very small amounts of impurities, or using continuous blowdown or other automatic concentration control, the blowdown of concentrates is a routine procedure usually carried out at 3, 4, 6 or 8 hr. intervals. Once this routine is established in a plant, little regard is taken of the variable rate of increase in the density of the solution or of the quantity of water evaporated between blowdown periods.

If the load upon a boiler is fairly constant—that is, if the quantity of water evaporated between blowdown periods is the same—regular blowdown of concentrates at multi-hourly intervals is a reasonably proper and efficient procedure to adopt. But when loads are highly variable and the concentration of solids in the feedwater high—conditions found in a possible majority of plants—routine blowdown may be ineffectual in keeping a boiler from foaming, reducing scale formation or preventing deposits of sludge from baking on metal walls and causing tube failures.

Careful observation of power plant practice shows that the mere opening of a blowdown cock for a period of several seconds each several hours of boiler operation is so often an inefficient method of reducing the concentration of solids that some variation in this procedure should be adopted. For under constant pressure a 60-sec. full opening of the blowdown cock will result in the escape of as much water from the boiler at one time as at another, regardless of the quantity of solids in solution or suspension in it.

Assume that the load upon a boiler varies from 50 to 150 percent of rating. If the load fluctuations are frequent and regularly reach not too extreme peaks and depressions between each blowdown period (Chart A), regular blowdown at multi-hourly intervals is acceptable, provided blowdown periods and intervals are of proper duration. During each interval the quantity of water evaporated is then nearly the same; at each blowdown period the concentration reaches the same density. And a 60 sec. blowdown period reduces the concentration to the same grains per gallon or parts per million ratio. Frequent and regular load fluctuations, no matter to what reasonable extremes, affects the blowdown hardly at all.

However, if major load fluctuations occur on a 24 hr. schedule from peak to peak, while blowdowns are carried out at regular fractions of this time, a highly inefficient condition exists (Chart C). A 60 sec. blowdown with open cock at the end of an interval during which the boiler operated at 50 percent of rating will result in the removal of only one-third as much solids as a 60-sec. blowdown after an interval during which the boiler evaporated water at 150 percent of rating. In the first case the concentration may be far from the precipitation point. Heat and treated water may be uselessly wasted. While in the second case the solids may build up to dangerous foaming or scale forming concentrations. Mention of the heat and treated water wasted in untimely blowdown is made merely to show that the loss in efficiency is at both ends of the scale. It is the condition of overdue blowdown, with the likelihood of engine priming or scale forming, which should be most guarded against.

To further clarify this point, consider the three charts, all taken from the same boiler, given herewith. While showing many pronounced fluctuations in load, Chart A indicates that the boiler is evaporating water at a uniform hourly rate throughout the 24 hr. period of operation. If at this evaporative rate the feedwater solubles reach foaming or sludge precipitating concentrations at the end of 10 hr. regular blowdown may be resorted to at the end of 8 hr. intervals, and give satisfactory results.

Chart B shows the boiler operating at approximately 200 percent of the evaporative rate recorded on Chart A. If the boiler water reaches dangerous foaming or sludge precipitating concentration at the end of 10 hr. under the conditions shown by Chart A, the same concentration will be reached in one-half that time, or 5 hr., under the increased rate of evaporation shown by Chart B. Under the increased load the boiler should be blown down at the end of 4 hr. intervals.

Chart C shows wide fluctuations in the hourly rate of evaporation, yet with approximately the same total amount of water evaporated as under the conditions shown on Chart A. But whereas regular multi-hourly blowdown is quite proper under the conditions shown by Chart A, regular blowdown, say at the beginning of each 8 hr. shift (7:00 a. m., 3:00 p. m., and 11 p. m.) would not efficiently deconcentrate the water under the conditions shown on Chart C. Forty percent more water is evaporated on the first shift (7:00 a. m. to 3:00 p. m.) as on either of the other two shifts. Beginning at 7:00 a. m., a foaming or sludge precipitating concentration would be reached approximately 2 hr. earlier than under the evaporative rate shown by Chart A.

While foaming is likely to take place at the time of peak loads, precipitation of sludge or scale will take place in the intervals of light loads. The cause of this may be found in the variable velocity of circulation. Since the size and number

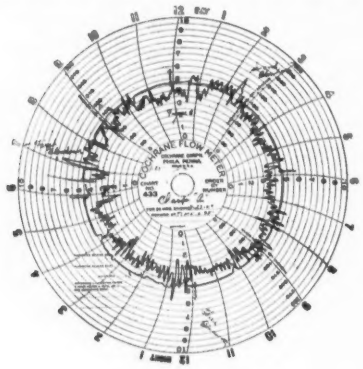


Chart A

Chart B

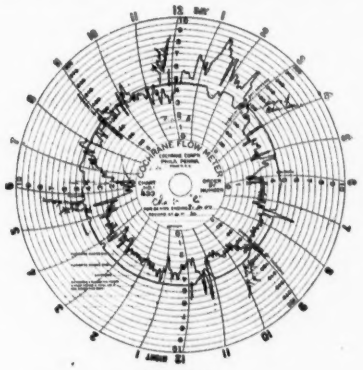


Chart C

of solid particles capable of remaining in suspension in a liquid varies directly as the sixth power of the velocity, a boiler being forced will retain practically all precipitates in mechanical suspension in spite of the high rate of evaporation. This is due to the rapid circulation caused by the violence of ebullition. Only when the evaporative rate begins to slacken appreciably will any sludge or scale be deposited. This is the danger point, for after peak loads the concentration will be high. A few minutes at 50 percent rating after a continued 150 percent peak may allow more scale to form than would otherwise be deposited during a full 24 hr. run at 150 percent rating without so much as one blowdown. Or a sudden demand for steam made upon a near saturated solution after a period of depression may cause extreme foaming, with resultant carryover into superheaters, engines or processing coils.

Referring to Chart C, the first blowdown after the first shift takes over at 7:00 a. m. should take place between 11:00 a. m. and 11:40 a. m., the second at a point along the line where the load falls after 3:00 p. m. A third blowdown should coincide with the 9:30 p. m. decline; while if the 5:30 a. m. to 6:30 a. m. depression is allowed to pass without a blowdown, precipitation of solids is likely to take place during the hour in which the circulation of water has almost ceased because of the extremely light load.

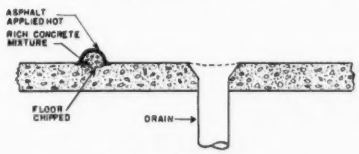
While unforeseen peaks and depressions in the evaporative rate cannot be guarded against, much may be done in many plants to space blowdown periods in conformance with known and predeterminable load variations. Firemen and water tenders may be instructed to deconcentrate by blowdown whenever a falling load line and estimated planimetric reading (or integrator reading) of the fllowmeter chart shows that the boiler water is approaching the foaming or precipitation point. Supplanting the regular time interval of blowdown with an approximate integrator record coinciding with a falling load line should show a marked increase in efficiency.

Curbs Under Stoker Ram Boxes Improve Housekeeping

By S. H. Coleman

THE OPERATION of underfeed stokers is quite often complicated by fires in the feed hoppers. This trouble is most commonly experienced immediately after lighting off a cold boiler or following long banking periods and is usually caused by the outward burning of fuel in idle ram cylinders. After the fire reaches the hopper, coking is likely to occur. Unless steps are taken to break up the resulting formation and extinguish the fire, feed through the affected ram will be interrupted and there will be an outpouring of acrid smoke into the room. Such an interruption of coal feed may seriously affect the fuel bed on the stoker and result in the exposure of one or more sections of the grate surface to the direct radiant heat of the furnace. Should this occur the metal may become overheated and damaged.

In the absence of permanently installed agitating devices, the time honored method of combatting this trouble is to break up the coke accumulation with a bar and then to extinguish the fire with water, using a hose terminating in a section of pipe that can be pushed down through the coal in order to reach the affected area. The use of water however, has a tendency to create an especially messy housekeeping condition especially where, as is generally the case, no provision has been made for its drainage.

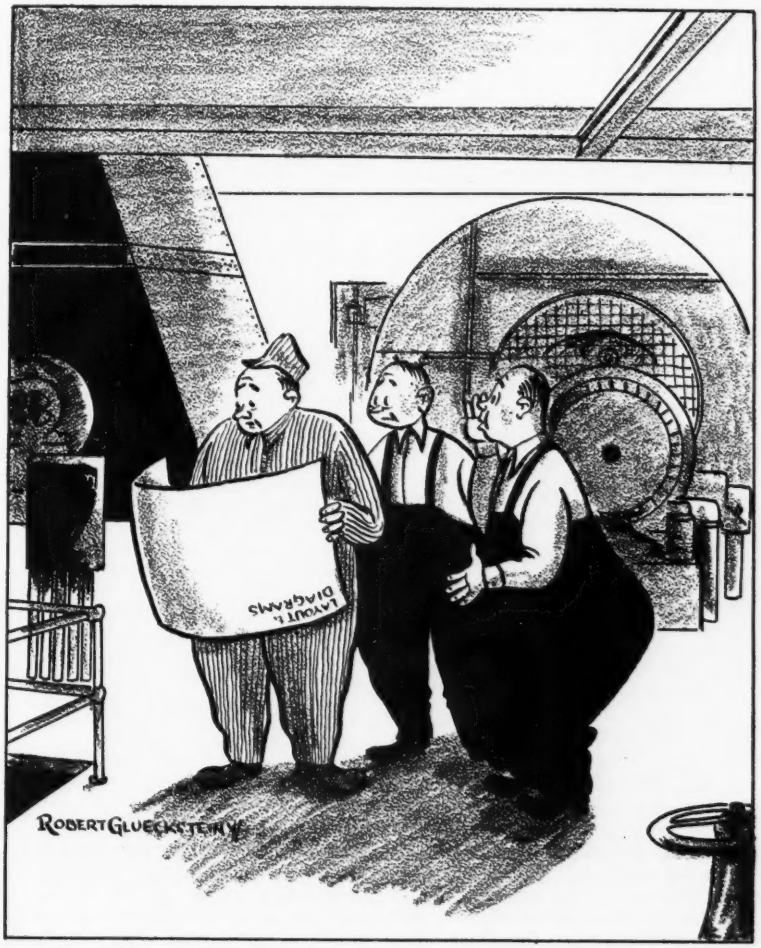


Curb under Stoker

In a large southern power plant boiler room, housekeeping has been greatly improved by building low concrete curbs to enclose the area under the ram boxes and providing drain lines as shown in the drawing. These curbs are half round in cross section and are bonded to the floor by chipping the old surface and using a rich cement mixture. After drying, the curbs are coated with asphalt, applied hot, to waterproof and protect them from mechanical injury.

Note on Use of 250 Year Calendar

VERNON PALEN, designer of the 250 yr. calendar presented on page 100 of the March issue, calls attention to an unfortunate distortion that occurred in making the chart. In assembling the chart when the March issue reached him, Mr. Palen found that the circle is not a true circle and as a consequence the graduations do not match up quite as they should. Since receiving Mr. Palen's letter we checked back to discover wherein the process of making the engraving the distortion occurred and found that it took place in making the photostat which served as "copy" for the engravers. We regret very much that this distortion occurred, but hope that by calling attention to it here, those that attempt to use the calendar will be warned of the distortion.



"I wish I knew some tactful way of telling him he's got it upside down!"

FOR THE PLANT ELECTRICIAN

Accidental Grounds on Unbalanced Neutral Systems

By Eugene George Key

SMALL FACTORIES whose power and light requirements are not large enough to warrant separate transformers for power and lights, use the system shown in Fig. 1. In this figure, the secondary windings of a 3 phase transformer are shown with the 3 phase lines A, B, and C and the unbalanced neutral tapped from the A-B winding. A, B, and C are the power lines and A, B, and neutral are the lines forming a 3 wire Edison system for lighting circuits.

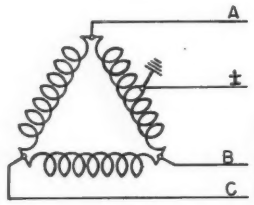


Fig. 1

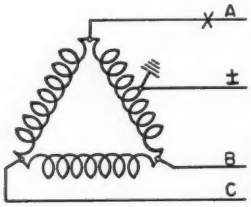


Fig. 2

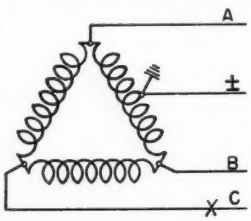


Fig. 3

Because of the unbalanced voltages from the phase lines to neutral, the maintenance electrician meets particular difficulties in locating accidental grounds. A knowledge of the theoretical conditions of the unbalanced voltages between phase and neutral under normal and ground-fault conditions will help considerably in locating troubles of all kinds.

Suppose that the voltages between A and B, B and C, and C and A are 230 v. Then the voltage between A and neutral and B and neutral will be half of this value, or 115 v. The voltage from C to neutral, however, will be 1.732 times 115 or 0.866 times 230, or 199 v. This condition should warn the electrician against using an ordinary light bulb to test all voltages between phase and ground. If a 115 v. lamp is used between A or B and neutral, nothing less than one 230 v. lamp or two 115 v. lamps in series should be used from C to neutral. If a 230 v. lamp is used from A or B to neutral, it probably will not light sufficiently to give an indication. A 115 v. lamp from C to neutral will explode. The same conditions exist if the test is made from any phase to ground.

Since the neutral wire is grounded at or near the transformer, this system cannot be tested in the usual way for the location of grounds. A lamp from phase to ground will always give an indication. A peculiarity of this system is that a full ground on any of the phases results in the elimination of that phase from the system so that the phase that does not give a light from phase to ground is the grounded phase. The reasons for this "dead phase" will be apparent from a theoretically practical consideration of this system.

Suppose an accidental ground occurs on A phase, as at X in Fig. 2. Theoretically, a full ground would have zero resistance between A phase and ground and, consequently, would allow infinite current to flow. The voltage between A and neutral would then be zero, and the voltage between B and A and C and A would be the same as the normal voltages between B and neutral and C and neutral, or 115 and 199 v. respectively. Actually, a current of two or three times the normal full load current rating of the transformer might produce an effect very near these conditions.

A full ground seldom occurs, however, but partial grounds are rather common. If a cable run is through a wet or damp area, the moisture can seep into the insulation and cause a leakage to ground. If conduit or other fittings are not tight, any vibration may rob the insulation thin and cause a partial ground.

Suppose a ground is severe enough to cause the voltage between A and neutral to drop to 50 percent of the normal voltage, or about 57 v. This voltage is too low to light a 115 v. lamp, and a lamp test will seem to indicate a full voltage ground. An accurate test can be made only with a voltmeter. The voltage from A to B will be 172 v. instead of the normal 230, and the voltage from C to A will be 207 v. For any degree of ground on A phase, the voltages in the system will have the following limits if the normal phase-to-phase voltage is 230:

A to neutral—0 to 115 v.
A to B —115 to 230 v.
B to neutral—steady at about 115 v.
B to C —steady at about 230 v.
C to A —199 to 230 v.
C to neutral—steady at about 199 v.

Any variations in these values will be caused by the fact that under load, no transformer output voltage is exactly constant. The normal phase voltage of a 230 v. transformer may range from 240 to 220 v. from no load to full load and varies with differently designed transformers.

If the accidental ground should occur on B phase instead of A phase, the same conditions will be present in relation to B phase as were described for A phase with a ground on A phase. Accordingly, the voltage limits for the system with a full or partial ground on B phase are:

A to neutral—steady at about 115 v.
A to B —115 to 230 v.
B to neutral—0 to 115 v.
B to C —199 to 230 v.
C to A —steady at about 230 v.
C to neutral—steady at about 199 v.

In Fig. 3, at X is represented a ground on C phase. The variations in voltages depending on the severity of the ground fault in this case are entirely different. The following table gives the limits on the voltages with a ground on C phase:

A to neutral—steady at about 115 v.
A to B —steady at about 230 v.
B to neutral—steady at about 115 v.
B to C —115 to 230 v.
C to A —115 to 230 v.
C to neutral—0 to 199 v.

It should be noted that with a ground on C phase, the voltages from B to C and from C to A will be approximately equal for any degree of ground fault on C phase.

An accidental ground on an unbalanced neutral installation is more serious than on almost any other system, as the voltage values in this article indicate. A ground on this system may put out not only about half of the lighting circuits in a factory, but will also interfere with the operation of all motors, heaters, furnaces, and other power equipment. A heavy ground on C phase, for instance, will reduce the system to an ordinary 3-wire Edison system—single phase. Accordingly, not a motor will start and those that are running will carry only a fraction of their rated loads if they will run at all.

Overloading Electrical Circuits

By George L. Radamaker

A COMMON practice in many power plants, is to add renewable fuse links to a fuse cartridge in multiple so that it will carry an increased load caused by greater power load added to the circuit caused by grounds or short circuits.

This is especially true in many refrigerating plants where electrical wiring passes through cooler walls and the insulation of the electric wire deteriorates rapidly. It seems to be a general practice to add a couple of extra links to a fuse to carry the load. I have seen as many as three extra links added to a renewable type fuse making a 30 amp. fuse capable of handling 120 amp.

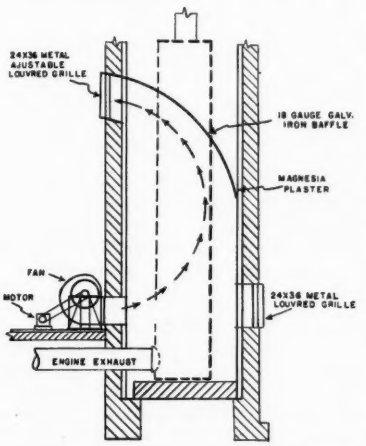
This should not be condoned even as a temporary measure, as it may be more costly in the long run if a serious fire is started. It is much better to install a fuse block from the service and run temporary open wiring to where it is to be used.

FOR THE DIESEL OPERATOR

Heating Diesel Stations

SEVERAL methods of heating Diesel stations by waste heat are available. Considerable quantities of heat at low temperature, not exceeding 150-160 deg. F. can be reclaimed from the jacket cooling water by circulating it, either direct to radiators or unit heaters or by means of an intermediate heat exchanger. Due to the low temperature, however, this is not as satisfactory as the use of waste heat boilers where higher water temperature, or even low pressure steam can be generated by the exhaust gasses.

Another method that is in fairly common use, and while it requires little equipment and gives good results is shown by the sketch. A section of the



Arrangement used for reclaiming heat from exhaust to heat engine room

exhaust pipe, or muffler is enclosed and air circulated over it by means of a small fan. In the sketch shown, the fan, mounted on the floor, takes its suction from the room, blows the air over the muffler and discharges through a grill near the ceiling.

The sheet metal baffle while not essential is effective in reducing eddy losses in the duct and in maintaining a high air velocity across the muffler so as to give good heat transfer. The grill should have adjustable louvers, which in some cases should be set for vertical, in some cases for horizontal deflection depending upon the shape of the engine room and number of units.

In the above plant, vertical deflection is used because there are several engines each with a heating unit. This gives good distribution of warm air throughout the length of the room, while proper distribution across the width of the room is obtained by adjusting the louvers. By closing the top louvers and opening the one at the back of the stack, the fans can be used for ventilating the engine room in the summer.

Low Temperatures Affect Diesel Operation

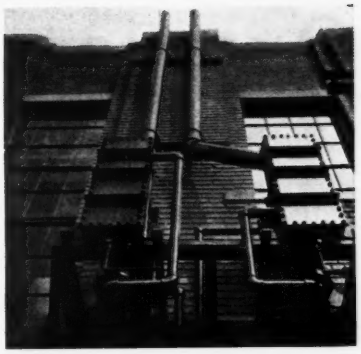
AFTER an engine has been built and delivered to the customer, there is little he can do about the combustion process outside of maintaining the equipment in good condition. The one variable which is reasonably under his control is operating temperature and where possible the combustion chamber temperatures should be kept high. Low temperatures tend to reduce the certainty of ignition, and a point may eventually be reached with some fuels where the engine misses badly or simply will not run. The engines will digest so called low quality fuels with least difficulty under the conditions which result in high combustion chamber temperatures. Conditions favoring high combustion temperatures are heavy loads, moderately high speed and heavy loads, high jacket water temperature and high air temperatures.

Low temperatures accompanying light loads have made it necessary for engines to use higher cetane fuel than that normally supplied. If the temperatures and loads both fall, further increases in cetane number are required. Test data on a high speed automotive Diesel at ⅓ load, about 32 hp., shows that a drop in water jacket temperature from 165 to 130 deg. F. raised the cetane requirement from 50 to 54. The combustion efficiency does not appear to be impaired by the lower water temperatures since the exhaust remains equally clear at the hot and cold conditions. Thickening of the lubricating oil due to lower temperatures affects the fuel consumption and the output by reason of the greater friction losses which result. W. S. Mount and G. A. Hope, Socony-Vacuum Oil Co., Inc., before the S. A. E.

Sewage Plant Recovery

THE City of Greensboro, North Carolina, has a peculiar problem in the disposal of wastes due to the fact that 25 percent of the total sewage flow consists of industrial textile drainage and amounts to 2,000,000 gal. per day, equivalent to that of a population of 20,000 people. Ordinary treatment as applied to domestic sewage is not adapted to handling textile wastes due to the irregularity of discharge and the toxic effect on biological organisms that are essential to usual sewage treatment. The arrangement worked out to meet these conditions are interesting. The brief account here presented appeared originally in an issue of "Heat Engineering."

The Greensboro disposal plant was designed accordingly, with utmost flexibility in operating methods and types of treatment. This flexibility is carried throughout the plant and is illustrated by the fact that there are four alternate methods of obtaining hot



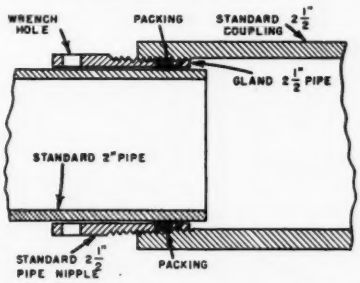
Waste heat water heaters in exhaust line from gas engines

water. The hot water is used in heating coils in the digesters to maintain a temperature of about 90 deg. F. in the sludge and thus facilitate the production of sewage gas. This digester gas in turn is used for heating and for power production in two 150 hp. engine-generators and furnishes over 95 percent of all power requirements. Thus it is apparent that an adequate supply of hot water is essential to the successful operation of the sewage treatment cycle. When the engines are running, the hot water is obtained from two, waste-heat water heaters, shown in the accompanying photograph, which absorb heat from the engine exhausts. Aside from the initial investment, the cost of obtaining this hot water is zero. Alternative supply of hot water may be obtained from engine jacket water, a coal-fired standby boiler, or two gas-fired boilers.

Expansion Joint from Ordinary Pipe

By W. F. Schaphorst

HOW TO MAKE an emergency sliding expansion joint out of ordinary 2 in. and 2½ in. pipe and an ordinary 2½ in. pipe coupling is shown by the sketch. A 2 in. pipe fits loosely into a 2½ in.



pipe with a concentric clearance of about 0.05 in. By using the tip of a standard 2½ in. pipe for a gland and sleeve, as shown, a sliding joint is readily made with packing placed between the gland and sleeve to prevent leakage. In a similar manner expansion joints can be made in other pipe sizes where the smaller size slips conveniently into the next larger size. Holes drilled into the sleeve permit tightening and loosening with a wrench.

Questions And Answers

114

Wants to Set Valves on Chuse Engine

Q. Would it be possible for someone to furnish me with complete instructions for setting the valves of a Chuse non-releasing Corliss engine, size 18 by 21, speed 225 r.p.m. The Chuse governor operates the admission valves only. The exhaust valve eccentric remains fixed. I will be grateful to anyone who can supply this information.

Columbus, Ind. JASON A. LACY

115

We'd Like Help to Get Oil Out of Boiler

Q. When I came to the laundry, where I am now working, 8 yr. ago, they had oil in the boilers and I have been trying to get rid of it ever since without success. Oil runs out of the manhole plates and has to be wiped up once a week to keep it from running on the floor.

We use 1 pt. of oil every day on our 160 hp., 4 valve engine, and 1 pt. every 2 weeks on the feed pump. This pump has a 3 cock oil extractor on the discharge side but it does not remove all the oil from the water. It is changed every day and the terry cloth socks are always full of oil when they are removed.

The engine takes steam at 110 lb. pressure and exhausts to 2 hot water tanks and the feedwater heater. The feed pump exhaust goes to the heater also. All oil separators are drained to the sewer continuously.

It has been suggested that we install a coke filter to take the oil out of the water as it leaves the feedwater heater. The sketch shows the proposed design. Before installing it, however, I'd like to ask about the experience of other engineers with oil problems of this kind. Will the filter do the job or can it be done easier some other way?

Saginaw, Mich. R. K.

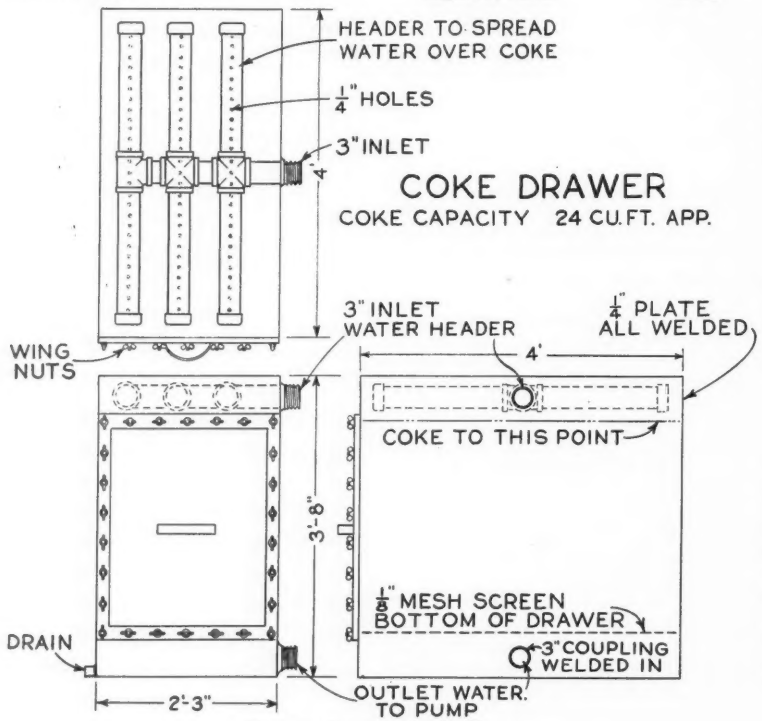


Diagram of proposed coke filter

A. 95

What Corrodes Most, Hot or Cold Water?

A. In answer to H. J. Moore's question (No. 95 in the Feb. issue) concerning the relative corroding powers of hot and cold water, we should like to state that we have found the hot water to be the most corroding; a finding that we have learned from sad and costly experience. The logarithm of the rate of corrosion increases in inverse proportion to the temperature, according to several authorities, who also suggest that an increase in temperature is accompanied by an increased chemical activity and a decrease in the solubility of the gases present in the water which, when freed from the water, become free to react with the metal piping. Electrolytic activity is also increased, especially around junctions of dissimilar metals as iron and copper or iron and brass. We have found theory to be well supported by facts taken from service conditions, for example: in 6 yr. we have had to replace only two small nipples in the cold water lines, while we have had to replace nearly 200 ft. of our hot water piping, all of which is of galvanized iron. 25 percent of the replacements were made necessary by local corrosion near brass valves; in this latter case, electrolytic rather than chemical action seems to have been the cause of the trouble.

Carlsbad, Calif. ALAN KNOX.

A. As chief engineer of a laundry and having just installed new pipe line in our plant, I have found that after 14 yr. both lines were in about the same condition. As all our water is softened, we were going to install copper pipe but after figuring the size of pipe and the thickness, and that the job would not be guaranteed, we installed wrought iron pipe and are very well pleased.

Newark, N. J. J. E. SERGEL.

A. My experience is hot water corrodes galvanized pipe much faster than cold water and deteriorates pipe much quicker. Would advise him to use his copper pipe in hot water lines.

We have much better success with brass pipe than all other kinds of pipe.

Akron, O. L. S. REED.

A. Replying to Question 95, by Mr. H. J. Moore, in your February issue. If this were asked in a radio question bee, the correct answer would undoubtedly be: "Copper pipe for hot water, and galvanized pipe for cold," and if the pipe is already on hand, the practical answer would be the same; however, if the pipe has not been bought, consideration should be given to the possibility of making a more economical investment.

Among commercial classes of pipe, copper is generally assumed to be the

most resistant to corrosion, but it is expensive, and, with some waters, brass, which is of course cheaper, may be practically as good, although it has been found that in some rather exceptional cases it has not been satisfactory.

Most water from the public supply has been treated, and this may have an important bearing upon its corrosiveness. If a sample of the water under consideration were submitted to one or more of the leading brass companies, they would no doubt recommend a pipe which would be both suitable and economical.

There are upon the market a number of non-ferrous alloys from which pipe is made, each of them being particularly suited to different waters. By following the advice of a reputable manufacturer, considerable saving might be made. Galvanized steel pipe may be fairly satisfactory for the cold water, provided it is not particularly corrosive, but galvanized genuine wrought iron pipe would be better and, with some waters, might be satisfactory for the hot water as well. This pipe is somewhat more expensive than steel but it may be well worth the difference in price.

In addition to the above, there are now on the market several makes of special corrosion resisting steel pipe some of them being in the stainless steel class.

JAMES O. G. GIBBONS.
Bloomfield, N. J.

A. 98

What Happens When the Condensate Pump Fails?

A. Certainly H. B. K. could operate the turbine if the condensate pump failed. The results would be, as he describes, namely: (1) filling of the condenser shell with condensate up to the ejector inlet pipe; (2) stoppage of the air pump; (3) loss of vacuum in the condenser; (4) opening of the automatic atmospheric relief valve; and (5) operation of the turbine non-condensing. The time required for the above to occur would not only depend on the condenser volume below the air ejector inlet, but also on the decreased rate of heat transfer through the condenser tubes due to water blanketing of the steam side of the tubes, thereby hastening the loss of vacuum. Probably several minutes interruption of the condensate pump would have but little effect on the vacuum.

However, the important question is not, could the turbine operate non-condensing, but rather, how *long* could it operate non-condensing. The loss of vacuum on the turbine will necessitate the immediate generation of approximately double the amount of steam to maintain the load. To illustrate this, refer to Fig. 1 and 2 which give the

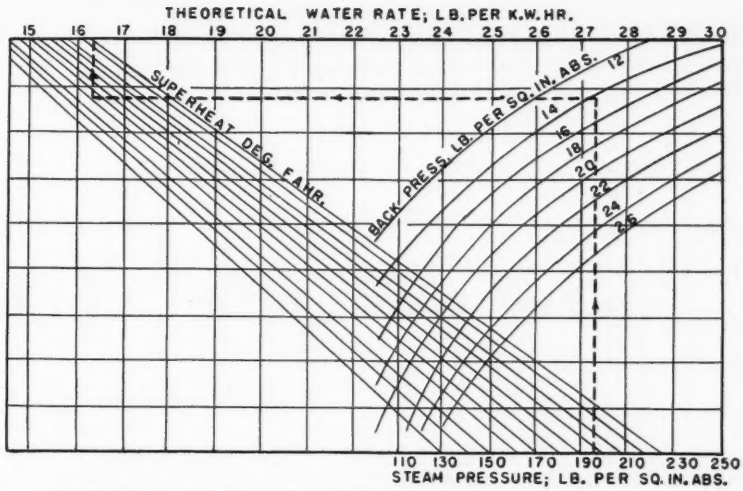

THEORETICAL WATER RATE; LB. PER K.W. HR.
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
SUPERHEAT DEG. FAHR.
BACK PRESS. LB. PER SQ. IN. ABS.
12
14
16
18
20
22
24
26
110 130 150 170 190 210 230 250
STEAM PRESSURE; LB. PER SQ. IN. ABS.

Fig. 1. Theoretical Water Rates of High Pressure Condensing Steam Turbines

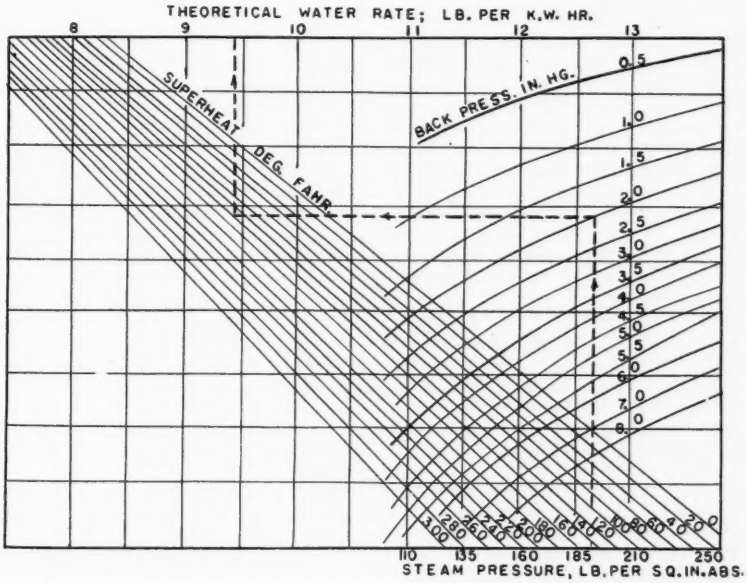


Fig. 2. Theoretical Water Rates of High Pressure Non-Condensing Steam Turbines

theoretical water rates of steam turbines in pounds per kilowatt-hour for condensing and non-condensing types. Actual water rates may be estimated by dividing the theoretical water rates by the engine efficiency of the turbine which, for a 500 kw. unit, will vary from about 65 to 75 percent. Assume, for example, a turbine throttle pressure of 180 lb. per sq. in. ga. (195 lb. per sq. in. abs. approx) with 145 deg. F. superheat and exhausting at 2.0 in. Hg. abs. back pressure condensing and at 14.7 lb. non-condensing. Following the dotted lines on Fig. 1 and 2 we obtain 9.35 and 16.25 lb. per kw-hr. or nearly double the steam consumption when operating non-condensing vs. condensing.

Unless there is ample reserve boiler capacity immediately available to supply this added steam (and very few plants have such reserve capacity), the only alternative is to reduce the load on the turbine until the condensate pumps are again in service. Such operations consume time and are expensive due to interruption of vital services.

Failure of the circulating water pumps would result in the same outcome as enumerated above, although the time required to overload the turbine would probably be longer than failure of the condensate pump.

A simple answer to the question without lengthy discussion of what may or may not happen with failure of condenser auxiliary equipment is to install reserve units for such emergencies. A plant engineer has enough headaches maintaining constant output without adding gray hairs because of lack of foresight or desire to cut first costs by neglecting to install essential reserve auxiliary equipment.

R. S. JULSRUD.
Harmon-on-Hudson, N. Y.

From an analysis of the various letters received regarding the hospital water supply problem in the March issue, it appears that the installation of an automatically controlled booster pump at the point where the service enters the building offers the most effective and at the same time inexpensive way of improving a bad situation. An overhead storage tank, probably, is the second best solution

How Would You Do It?

PROBLEM 15

HOSPITAL WATER SUPPLY

STRANGE things happen in this department; indeed, if the Board of Judges doesn't go nuts or if it doesn't get an injunction or a habeus corpus or whatever it is they need to keep Our Hero from inflicting his half-baked problems on the general public, it will take more than a few paltry prizes to save whatever reputation for veracity we have. In the March issue, it will be recalled, Our Hero presented a water supply problem, one, which he claimed, had confronted him for 18 yr. It involved a 2½ in. supply line to a hospital, a line obviously too small, but nothing could be done about it. That line, because of the expense it would involve, could not be enlarged—so Our Hero said. So he put it up to you readers; what would you do about it?

Well, you did plenty. For a while letters poured in at a tremendous rate with all sorts of suggestions, most of which centered either on the use of an overhead storage tank or a booster pump to step up the pressure. This, naturally, was gratifying since it proved that this department could be of practical help to someone in need of advice.

In this particular case, Our Hero happened to be none other than our old friend Arthur H. Parker of Peterboro, N. H., whose name has appeared on these pages on previous occasions. As Mr. Parker expressed himself in a letter written on February 5th: "This problem has continued through 18 yr. of operation and only recently have any steps been taken with an idea of future correction. . . . Before we spend any money I want to be sure that I am giving the right advice."

So the problem was placed in the mouth of Our Hero, figuratively speaking, and presented as Problem 15 in the March issue. The results, as indicated above, were gratifying. The replies were practical and comprehensive; many excellent suggestions were made for overcoming the difficulties.

Now, however, after all the replies are in and the contest practically over, Mr. Parker writes another letter in which he announces that the town, "much to my surprise, voted to put in a 6 in main this summer!"

However, strange as it may seem that after 18 yr. the town should see fit to enlarge the supply line at the very time that other efforts were being made to correct the trouble, Mr. Parker will still have to take steps to make changes in the hospital itself. As he pointed out in his original letter, "I maintain that no matter how much we increased the size of the supply pipe to town—the problem would still continue owing to the layout inside the building where the 2½ in. feed is immediately cut down to 2 in. branches."

The many suggestions made in the answers to the problem, therefore, still hold good. The 6 in. supply line, of course, will make more water available at the entrance to the building but the problem of distributing the water throughout the building still remains.

In making the awards, A. C. King's letter was given first prize because of the logical way it attacks the problem and for the fine graphical analysis of the action of the booster pump under varying conditions of load.

The three prize-winning letters follow:

First Prize Award

A. C. King
Consulting Engineer
Chicago, Ill.

One solution, and the one which would probably provide the most satisfactory service, would be to provide an elevated storage tank which would fill at times of low demands on the supply main and would supplement it when the demands would otherwise be sufficient to materially reduce the residual static water pressure. During heavy drafts the storage would furnish much of the water, thus reducing the demand on the supply main, thereby decreasing the drop in pressure. In order to determine the size of the tank needed, a fairly accurate idea of the maximum demands and their frequency and duration should be obtained. This can be done by simultaneously timing the opening and closing of the various valves during the peak demand period and faucets and noting the corresponding water pressure. Often the cost of providing adequate elevated storage will be prohibitive, especially as there are no available structures with sufficient strength to support

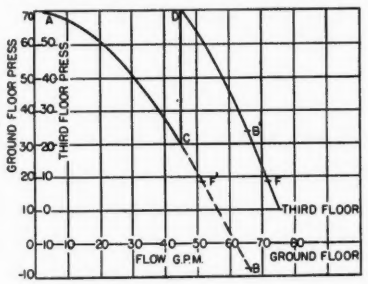


Fig. 1

the necessary weight. Another factor often to be considered is prevention of freezing.

Another alternative is a pressure storage tank with an air cushion. This is an expensive system, as tank must be built to withstand air pressure equal to the maximum system pressure at the elevation where it is located. Means for providing air pressure are necessary to make up for absorption, leakage, etc. It should also be noted that variations in pressure between the "full" and "empty" levels in the tank reduce the effective water storage to not over 60 percent of the total volume and frequently the effective volume percentage is much less.

A third method is the installation of a booster pump. Obviously, the most natural place to install it would be in the basement of the hospital. However, before doing so it should be established that the desired maximum rate of flow should not cause the pressure in the main at the pump suction to fall below

a maximum of about minus 8 lb., corresponding to a vacuum of about 16.5 in. of mercury. A greater vacuum will probably lead to trouble due to gland leakage, etc. It should be noted that the most effective rating of a pump for booster purposes does not coincide with its normal rating. Full data should be furnished to a reliable pump manufacturer and his recommendations obtained before specifying the pump characteristics.

In case the desired maximum flow rate would cause the pressure in the main at the hospital to fall below the specified minimum pump suction pressure, the pump might be located back along the line opposite to the direction of flow, as the head loss due to friction is reduced in proportion thereby.

It is not desirable that the booster pump run continuously, being a waste of power causing excessive wear and building up unnecessary pressure on the system when little or no water is being drawn.

It is therefore desirable to provide automatic start and stop for the pump. This can be done by installing a pressure switch to cut in the pump when the pressure delivered to the system drops to a predetermined point and cuts out after the pressure reaches a certain maximum and has remained at that point for a predetermined time, so that the pump will not start and stop continuously at any time. However, a simpler and much better scheme is to install the pressure switch in the pump suction, which will cause the pump to operate at all times when the flow of water exceeds a certain value and to shut down when the flow is lessened, and the pressure in the system ahead of the pump builds up to the desired point.

The accompanying graph (Fig. 1) is intended to illustrate the pressure vs. flow relations, although the values are arbitrarily assumed, but probably somewhere near the actual. The curve ACB represents the main pressure at the ground level with varying water demands. Under the assumed conditions there will be no pressure in the main at the ground level when the flow demand is 61 g.p.m. and no pressure at the third floor when the demand is 56 g p.m. The booster pump would cut in at C when the demand exceeds 45 g.p.m. and the main line pressure falls to 30 lb., the pressure at the building then will be raised to the no-flow level of 70 lb. by the booster pump. Additional flow will reduce the pressure while the pump continues to operate until point F is reached which is the minimum pressure satisfactory at the third floor level. Without the pump, this point would be at F′; while at first it might seem that the pump has not increased the system capacity very much (approx. 38 percent under the assumed conditions), it should be remembered that according to the mathematical law governing the probable flow of water in a system with a number of fixtures is increased, the probability of the flows becomes very small after a certain maximum is reached. This point can best be determined from the test data obtained as outlined in paragraph 1.

The pressure point at which the booster pump should cut out would ordinarily be 2 or 3 lb. above the cut in pressure to avoid too frequent starting and stopping. In consideration of the diagram it should be noted that the point F is beyond the point B which was assumed to be the maximum flow point at which the pump suction would be—8 lb., hence to attain the full benefit of the booster pump it should be placed back in the line towards the source of supply.

In order to avoid excessive pressure loss due to flow through the pump when not operating, it is usual to bypass the pump with a check valve which closes when the pump starts.

Second Prize Award

R. S. Bean

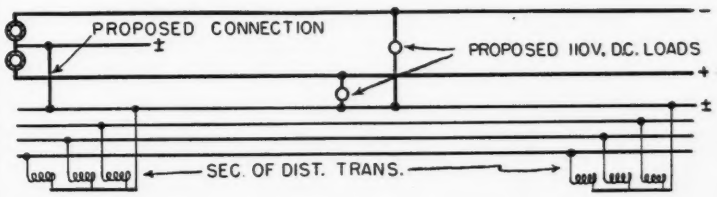
Engineer, Champion Paper & Fibre Co.
Pasadena, Texas

An analysis of the data supplied by "Our Hero" brings out the fact that the pressure difficulty is only experienced when the laundry is in operation. Also, sufficient pressure is obtainable at all parts of the hospital by partially closing the valves to the laundry washer. Since increasing the supply main is out of the question, there are two general solutions remaining which will maintain the pressure at peak loads.

Before discussing the details of the two methods it is necessary to determine the maximum flow demand to be encountered. A 2½ in. line 1 mi. long will have a pressure drop of approximately 115 ft. with a flow of 40 g.p.m. and 145 ft. for a flow of 45 g.p.m. Therefore, it is safe to assume that a total flow of less than 50 g.p.m. is available at the hospital unless the city main pressure is over 200 ft., which would be unusual. The important thing to be noted is the fact that after 50 g.p.m. flow is reached the pressure drop in the line will increase very rapidly reaching 365 ft. at 75 g.p.m.

One method of compensating for the line drop at peak loads would be to install a booster pump in the water line to the hospital. By installing a high head pump at the point where the 2½ in. line joins the city main (which is probably out of the question) it would be possible to overcome the large line pressure drop resulting and obtain a flow of around 75 g.p.m. with the necessary head to supply the hospital at all times. This would not be an economical system as the pump would necessarily run continuously and the majority of the power would be wasted for the extra head and flow is needed only occasionally.

PROBLEM 16
INTERCONNECTING THE NEUTRALS



Genius that he is, Our Hero has been toying with an idea—an electrical idea if you please. In one of the countless plants he has charge of, there are two electrical distribution systems; one, a 4-wire, 3 phase, a.c. system and the other a 3-wire d.c. system. These systems parallel each other throughout the factory, but in recent years only the two outside wires of the d.c. system have been extended to new wings of the factory. The neutral of the d.c. system was not carried to these parts of the plant. Now, however, there is a need for a number of 110 v. d.c. services and it becomes necessary to install the neutral, "or else." The "else" is what Our Hero has been thinking about. He is thinking of interconnecting the neutral of the a.c. system with the d.c. neutral as shown in the diagram so as to make the former serve both systems. The a.c. system is well balanced and, normally, there is little alternating current in the neutral. The idea seems simple on paper but our hero is not certain that it is feasible. Are there any hidden pitfalls in the proposed arrangement and what kind of trouble, if any, is he liable to encounter?

Write out your opinion of this problem in a letter of not over 1000 words and send it to the Contest Editor by May 25. A first prize of $15 will be awarded for the best letter, a second prize of $10 and a third prize of $5. Entries should be addressed to the Contest Editor, Technical Publishing Co., 53 West Jackson Blvd., Chicago, Ill.

By installing a small booster pump of about 60 g.p.m. and 60 ft. head, as shown in Fig. 2A, the necessary extra capacity could be obtained at the third floor outlets when the laundry is operating. It would be useless to install a pump of greater capacity, for as noted above, the line drop to the hospital would limit the flow to the pump suction to around this amount. Such a pump would require a 2 hp. motor and the total installation should cost around $200 if the laundry man is capable of making the connections.

The starter switch for the motor should be installed by the laundry washer, if possible where the laundry man could run it while the washer operates. The check valve in the bypass around the pump keeps the water from circulating when operating and also allows the line to supply the hospital when the pump is not operating.

Disadvantages of this scheme are as follows: 1. Only a limited increase in flow is obtainable for peak loads and if further demands were connected to the line they could not be accommodated. 2. Depending upon the power charge for the hospital the yearly power bill might be fairly high. 3. There are maintenance and depreciation charges to be contended with in calculating the ultimate cost.

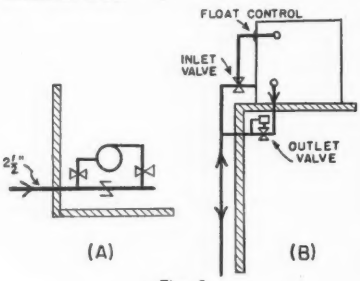


Fig. 2

The method I would recommend over the above would be the installation of a storage tank on the roof. The piping connections are shown in Fig. 2B.

During periods when the laundry is not operating, the tank will automatically fill until the float cuts off the inlet valve. The pilot valve is set so that if the pressure in the inlet line drops below the pressure corresponding to the head of water in the tank, the outlet valve will open and the tank will supply water to the hospital in conjunction with that furnished by the supply line.

As soon as the water demand which caused the pressure to drop is stopped, the pressure will again build up and fill the tank and close the outlet valve. A check valve could be substituted for the outlet valve for the sake of economy, if a drain from the tank is provided in case of leakage through the check with only a small differential pressure against it, or if it should stick partially open.

The tank could be constructed of wood or perhaps purchased second hand locally. A tank of about 4000 gal. capacity should prove of sufficient size for the present demand and also supply future outlets which are not left open for too long periods of time. It is important to remember that no continuous loads can be connected which will keep the pressure below that necessary to fill the tank, for, of course, no storage could be accumulated.

The advantages of this method are: 1. No power costs are added to the hospital bill. 2. A much larger flow of water can be obtained for short periods of time than can be supplied by the 2½-in. line. By installing a large line to the tank, several hundred gallons a minute could be delivered to any point in the hospital if it were desired later on. 3. Maintenance should be very low. 4. If water is not available for a fire system at present, a larger tank could be constructed and the lower half used as a storage tank for such purpose.

Third Prize Award

A. N. Pringle
Maintenance Engineer
Ohio Public Service Co.
Warren, Ohio

To SUPPLY the desired quantity of hot and cold water at all times to all parts of the building, the installation as shown in Fig. 3 would give very satisfactory results at a reasonable cost.

From the information given, the approximate supply of water is 20 to 25 g.p.m when the wash valves are open. This, however, is assuming a 60 lb. pressure drop in the supply system for pipe in good condition.

To analyze the sketch we will use a pump of 50 g.p m. at 40 lb. pressure and 50 lb. shut-off pressure and a 500 gal. suction storage tank. First, under normal conditions, water is supplied through 1—2 and 6, then with the regulator adjusted to close the motor switch at the minimum desired pressure and to open the switch at shut-off pressure. The wash valves are opened, pressure drops to a predetermined point and the pump starts with an available capacity of 50 g.p.m. for approximately 20 min. This would exceed the demand by a comfortable margin and permit the pump to run at short intervals between which the storage tank supply would be replenished. A partial vacuum in the top of the storage tank would increase the flow and the equalizing line from the tank to the suction cavity at the pump will keep the pump full of water until the tank is completely emptied. The latter should never occur.

Since the wash valves are 1½ in. and no complaint about supply for them, we can only assume it was sufficient. This being the case the next step would be to reduce the size of these valves or, if we do not care to spend the money for smaller valves, we can install an orifice in these lines to maintain the same flow as before the installation. The 1 in. flushometers can also be equipped with an orifice to reduce the flow if no other adjustment is provided. I don't think

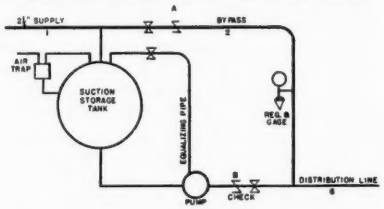


Fig. 3

it necessary to bother about the ¾ in. faucets since there will be a plentiful supply and the persons using them will no doubt have to keep these valves throttled.

We would install one air trap of a conventional design with a check valve in the air discharge pipe. The trap would discharge any air collecting in the tank and the check valve is installed in the discharge to prevent air from coming back through the trap while the tank is being pumped down.

The check valves A and B are naturally to direct flow. Other valves indicated in the sketch would be very convenient, however they are not necessary.

General Comment

Among the many other excellent letters deserving mention, the one sent in by A. E. Gethoefer of Buffalo, N. Y., is of interest because in it Mr. Gethoefer explains how he solved a similar problem in the hospital he is connected with. Quoting from his letter, "I had the same problem to work out that you (Our Hero) have, so I drew a picture (Fig. 4) to show how I did it. First, I checked my log to find the average use for the year, per day (I was a new man). Then I found out that the present heater was not doing such a good job so I bought a new 4-pass hot water heater.

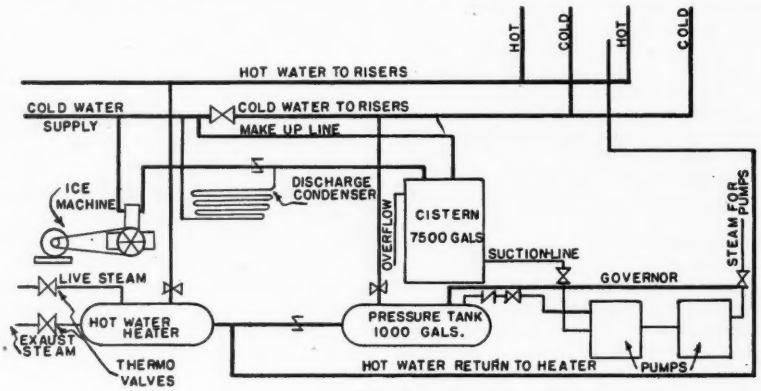


Fig. 4

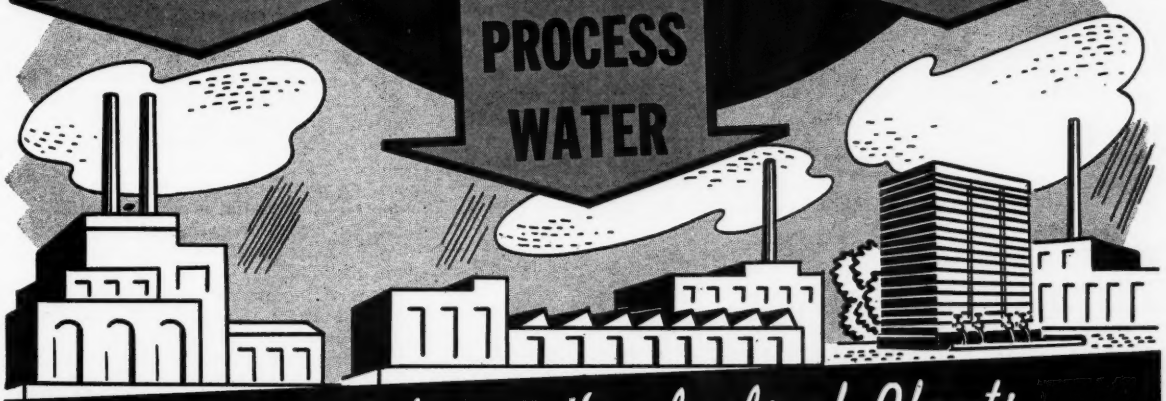
Investigate the Advantages of Nalco's ALGAE and SLIME CONTROL SERVICE

1. QUICK ACTION
2. EASY TO USE
3. ECONOMICAL
4. EFFICIENT

for SPRAY PONDS

for COOLING TOWERS

for PROCESS WATER



On the Job in Hundreds of Plants

NATIONAL ALUMINATE CORPORATION

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Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

I removed the tubes from the old heater and converted it into a pressure tank. Having available an old boiler feed pump, I hooked that up as shown in Fig. 3, installing a pressure regulated valve on the pump that would operate the pump in accordance with the pressure variation. I also found that the water on the ice machine was running to the sewer, so I built a cistern in the room next to the ice machine and discharged the water from the ice machine into it. This water, I piped to the suction of the booster pump and then I put a stop valve in the cold water supply to the laundry and closed it. That stopped the pressure drop on the cold water and as they used only half the amount of hot water as they did cold water in the laundry, that was the only boosting I had to take care of . . . the booster pump took care of the hospital with water from the ice machine and city pressure took care of the laundry. . . . Before these changes were made, we were using an average of 5000 gal. of water per day. Now we are using 2500 to 3000 gal. per day. You may be inclined to doubt this, but with good pressure and good hot water, where and when you want it, there is less waste of running water. This saving, plus the wasted water from the ice machine, plus a lot of work on toilets, showers, etc., cut the water bill about 50 cents a day."

It is always interesting in analyzing the results of these contests to note how different contestants present similar ideas in different ways. The storage tank idea in this instance was quite obvious, but no two contestants connected it in quite the same way. Some suggested an overhead tank working with gravity, others used a pressure tank in the basement. An excellent example of the latter is shown in Fig. 5 submitted by Prescott R. Nichols, Electrical Engineer of the Municipal Lighting Dept., Reading, Mass. In his letter, Mr. Nichols says that he assumes that there are intervals during the day when no water is being used in the laundry. The laundry supply is taken from the main supply ahead of the check valve. The other supply lines to the hospital are taken from a point between the check valve and the tank as shown. When normal city pressure is on, the tank should have ⅔ water in it and ⅓ air. If no air compressor is available, Mr. Nichols suggests that a compressor and motor from a domestic refrigerator would make an excellent outfit. Mr. Nichols also suggests the use of an electrically operated pressure controlled

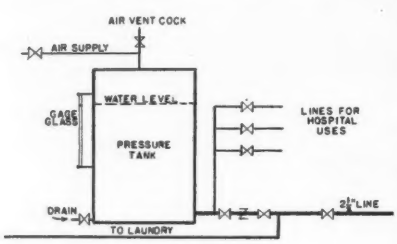

Fig. 5

booster pump as an alternative arrangement.

G. B. Garnett of Chicago feels that the booster pump provides the most satisfactory solution to the problem. If it can be assumed that there is sufficient water at the source of supply and if it can be brought to the hospital without changing the main supply line, then, he points out, there is but one solution with a minimum of expense. First, he would install a booster pump. Secondly, "I would reduce all my valves and faucets. In place of the 1½ in. laundry valves I would put in 1 in. or possibly ¾ in. valves and change the ¾ in. faucets for ½ in. faucets Likewise I would change the 1 in. feed on the flushometer to a ¾ or ½ in. if it were possible to get enough flow through the smaller line. The reason for these reductions at the outlets is to give the pump an opportunity to build up pressure. When a number of large valves and faucets are opened at one time the combined capacity is greater than the flow through the 2½ in. main. The lower valves, therefore, take all the pressure. By installing smaller valves, however, and also the booster pump it should be possible to force water to the third floor level."

This suggestion of reducing the size of the valves and faucets is a practical one and one that only few made. It is a simple and effective method of reducing the amount of water used (and probably wasted) and would result in keeping the pressure up.

One factor of importance that many contestants directed attention to was the inadequacy of fire protection. It may be that an adequate fire protective system is available, but it was not referred to in the original statement of the problem and if the 2½ in. supply line is the only means of getting water to this institution, the protection is poor indeed.

Among other letters deserving mention are those of C. C. Collins of Monmouth, Oregon, and Glen Browning of Columbus, Ohio. Without explaining how he arrived at the capacity, Mr. Collins suggests the installation of a 50 g.p.m. pump at a point where the 2 in. line connects to the 2½ in. main. The pump, he points out, should develop a pressure of about 75 lb. and should be controlled automatically. These figures are very close to being correct.

Mr. Browning suggests several solutions but favors the booster pump method. If storage is desired, however, he recommends the use of two tanks, one for hot water and the other for cold water.

No problem contest would be complete without a dis-solution from Pulverizer Pete.

"Hot dog!" he writes, "I knows the answer; it is the same like it was last time; you takes a wrench and tightens the nuts on the squirrels in the synchronous motor on the town pump.

"Now, if that ain't the answer I guess for once I don't know nothing about Problem 15 so here is another answer

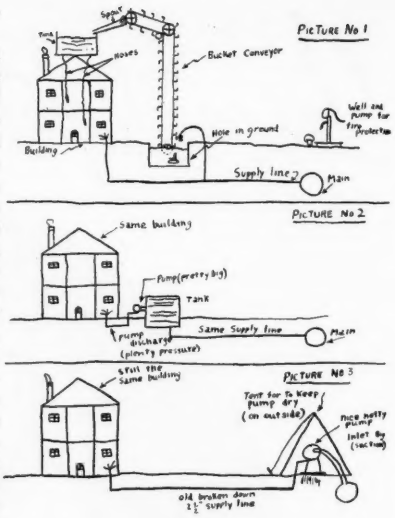

Fig. 6

anyway. You sends the laundry out to the local Asiatic, then you don't need no water for it and the Docs, they get plenty."

Then he quotes a passage from Confucius as follows: "Best way for to have water where you want it is to put water above where you needs it." We don't believe Confucius ever said that but it represents Pete's way of suggesting the use of an overhead storage tank.

"Picture No. 1," he continues, "shows how to rig up an arrangement for to do this. It is a hole in the ground which gets filled with water from the supply line when it ain't too busy. A bucket conveyor takes the water up to a tank on the roof. From this tank a couple of hoses runs down to the main halls in the building. Then, when anybody has to have more water he runs to one of the hoses and pulls it after him to what he wants to fill with water.

"Still sticking to the tank idea, Picture No. 2 shows how to fix up a system using a tank and a pump without putting the tank on the roof and without messing with the inside piping layout. . . .

"Picture No. 3 shows one other way how you might fix up your trouble if you can dig up the town main and connect a pump to it with a decent size piece of pipe. That is, you puts the pump at the far end of the 2½ in. line and shoves the water instead of letting it trickle in. How much pressure your pump has got to put out under such a hook-up is your problem and you better figure out whether it is gonna blow up your supply line. You better put in a pressure switch with this scheme on account of you don't want your pump should run just because some nurse wants a glass of water for a chaser at 3 a. m.

"The first prize which by this time you owes me entitles you to one more little answer. That is, you could make the Docs carry in their water in buckets and then the laundryman could have all the water he wants."

LUNKENHEIMER

125 lb. S. P.

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Fig. 2129
Single Wedge Disc
Non-Rising Stem

Fig. 2125
Double Wedge Disc
Rising Stem

LUNKENHEIMER

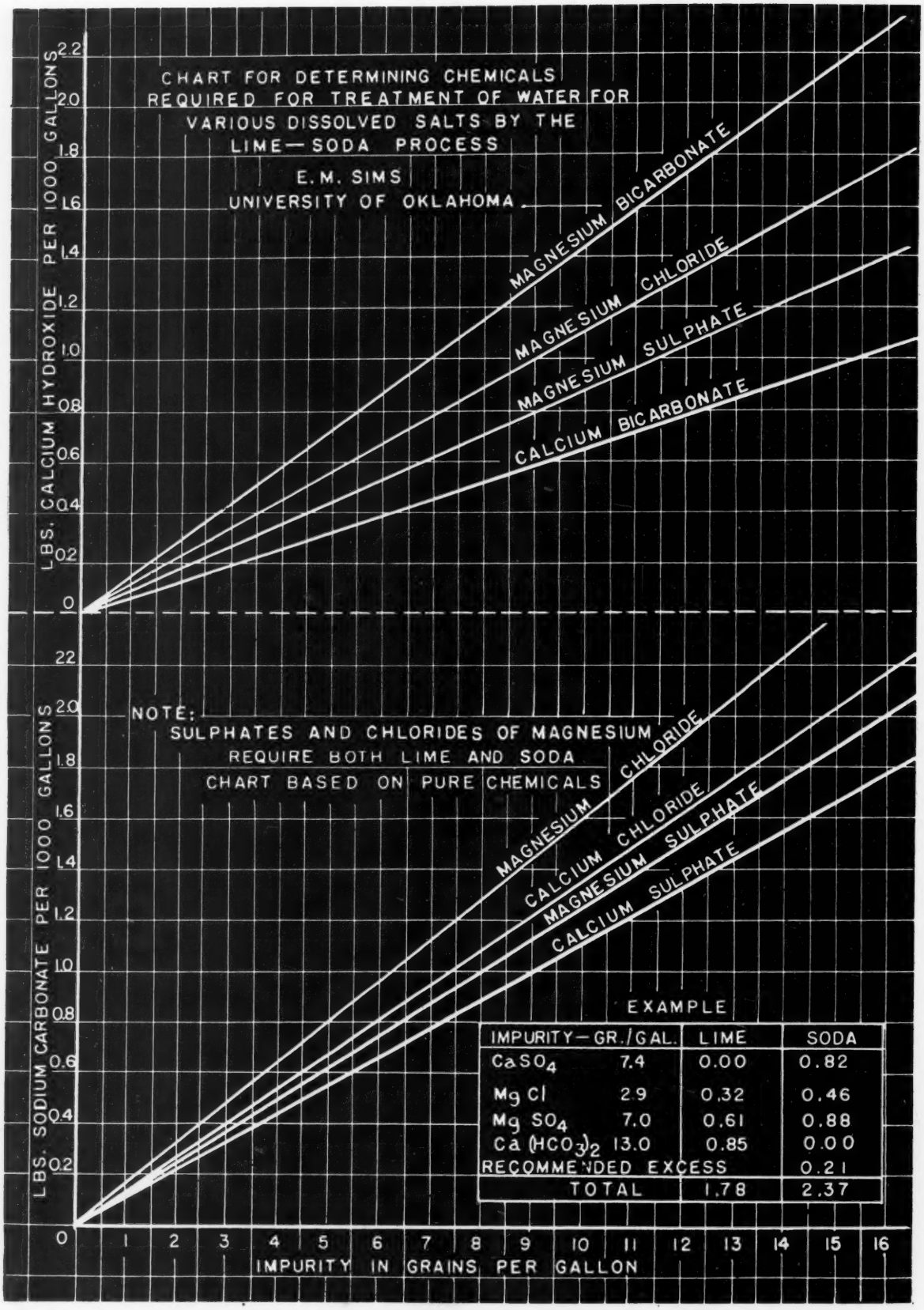
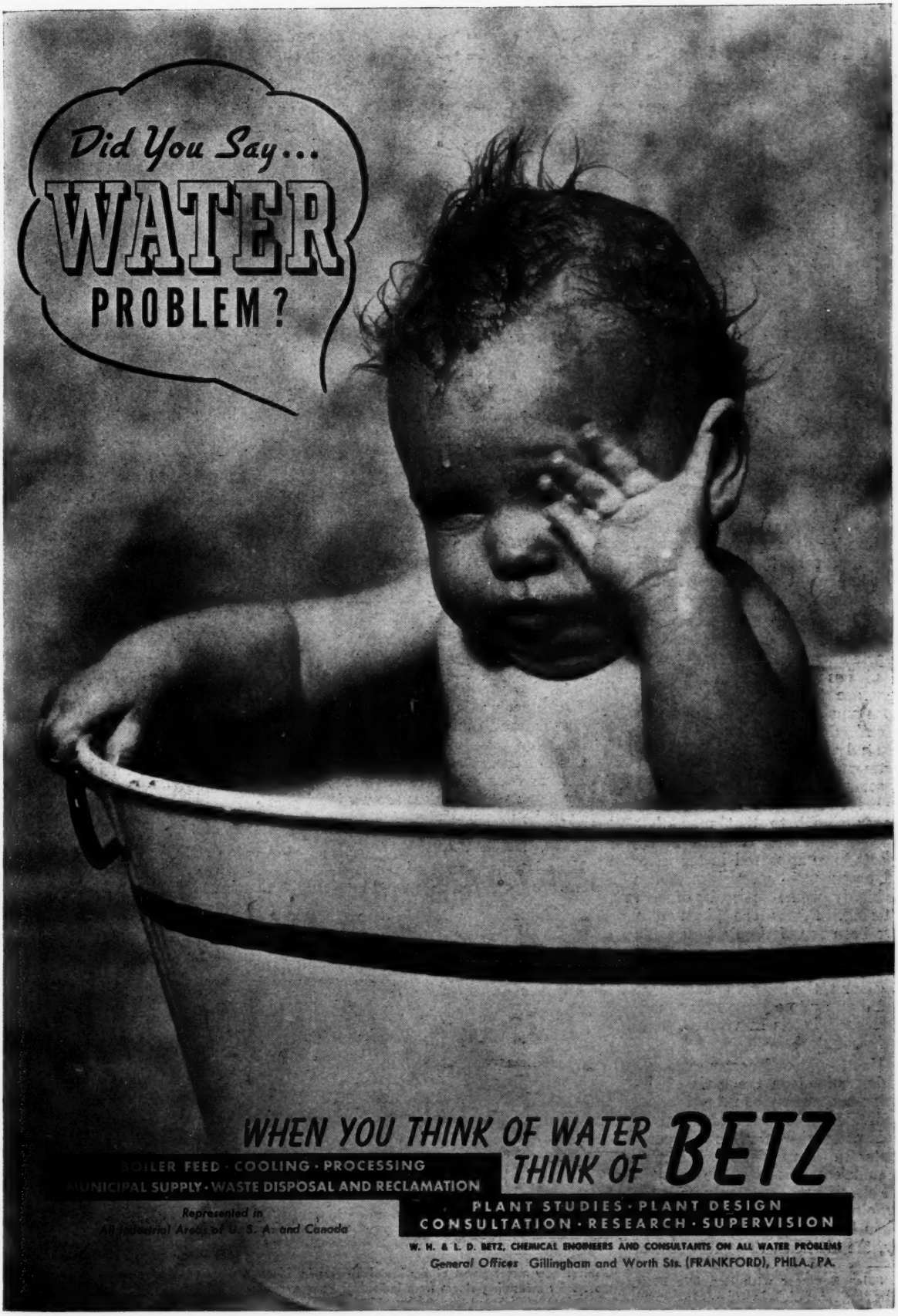


CHART FOR DETERMINING CHEMICALS REQUIRED FOR TREATMENT OF WATER FOR VARIOUS DISSOLVED SALTS BY THE LIME—SODA PROCESS
E. M. SIMS
UNIVERSITY OF OKLAHOMA
LBS. CALCIUM HYDROXIDE PER 1000 GALLONS
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2
MAGNESIUM BICARBONATE
MAGNESIUM CHLORIDE
MAGNESIUM SULPHATE
CALCIUM BICARBONATE
NOTE:
SULPHATES AND CHLORIDES OF MAGNESIUM REQUIRE BOTH LIME AND SODA
CHART BASED ON PURE CHEMICALS
LBS. SODIUM CARBONATE PER 1000 GALLONS
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2
MAGNESIUM CHLORIDE
CALCIUM CHLORIDE
MAGNESIUM SULPHATE
CALCIUM SULPHATE
EXAMPLE
IMPURITY—GR./GAL. | LIME | SODA
$CaSO_4$ 7.4 | 0.00 | 0.82
$MgCl$ 2.9 | 0.32 | 0.46
$MgSO_4$ 7.0 | 0.61 | 0.88
$Ca(HCO_3)_2$ 13.0 | 0.85 | 0.00
RECOMMENDED EXCESS | | 0.21
TOTAL | 1.78 | 2.37
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
IMPURITY IN GRAINS PER GALLON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METERING SAVES HOTEL MONEY

Hotel operating engineers and many successful hotel managers have proved the economic value of meters. Heat, light and power are large items in most hotel expenses and should be carefully measured and analyzed

By Charles W. Parsons*

METERS are vivid examples of the fundamental fact that "Saving a dollar avoids the work and effort necessary to make a dollar of profit." If we are to believe what all hotel men tell us, there is so much competition in the hotel business that profits are small. Accepting that fact, saving $100 is as important as selling perhaps $1000 worth of rooms or food.

An increasing number of successful hotels have installed meters on principal heat, light and power lines. The resulting accurate quantities are tabulated on simplified forms and charges for each service to each department are itemized for study by the head of that department. An increase in the cost of some service with no greater need for that service then is a danger signal to that man that someone is wasting dollars. Many reports have appeared in the hotel and power plant magazines giving the highly profitable results of such metering. Forms are given that have been found simple to use for these records. While no two hotels are identical in equipment and arrangement, the following comments should apply to a great many moderate sized hotels in various parts of the country.

Heat, light and power costs can be determined on the basis of departments. They can be further subdivided into costs of separate kinds of services for those departments. In the smaller hotels it may be sufficient to meter the services and classify the costs only as heating, electric light, live steam, etc.; but in hotels of good size the laundry, the kitchens, the guest rooms, etc., are probably each in charge of a department head and costs and profits are computed on a departmental basis. In those cases it is of vital importance to have these costs chargeable directly to each department and the man in charge.

Are the following departments existent in your hotel or could they be used as bases for this classification of heat, light and power costs?

Boiler operation
Power plant outside boiler operation
Guest rooms (including elevators)
Public rooms
Kitchen and dining rooms
Laundry
Concessions, stores and tenants.

Let us examine each of these briefly to see what services are used that can be measured.

Boiler Plant

Here is where most of the fuel dollars are spent and converted into steam for heating, lighting and power. The efficiency of the boiler plant should be checked by continuously reading meters of: 1—fuel quantity burned; 2—total steam generated; 3—efficiency of combustion (measured by percent of CO_2 in the boiler exit gases); 4—condition of boiler tubes (temperature of exit gases); 5—steam pressure; 6—steam temperature; 7—indicating draft gages are a valuable guide to firing. Automatic control of steam pressure and combustion conditions assures better performance of steam driven generators, pumps and other power units, and furnishes the proper quantity of air to burn the necessary fuel most efficiently.

The Power Plant Outside the Boiler Operation

This is the receiving station of the wholesale quantities of heat, light and power and also the distributing point for the retail quantities to each individual department. Wholesale quantities to be measured include:

1. Steam from the boiler plant.
2. Cold water from city mains or private wells.
3. Electric current from any outside source.
4. Refrigeration purchased from outside supplier.

Converted quantities to other forms of service:

5. High pressure steam used for generating electricity.
6. High pressure steam used for pumps, compressors, fans, etc.
7. Reduced pressure steam for kitchens, laundry, etc.

(Continued on Page 140)

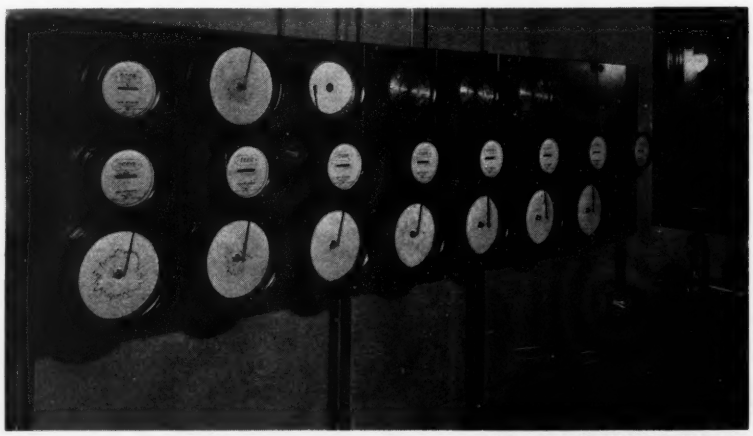

Photo courtesy Republic Flow Meters Co.

Central flow meter panel at the Hotel Stevens in Chicago upon which are mounted seven meters for measuring steam from individual boilers, one each for steam to the laundry, the kitchen, the refrigerating units and air from the compressor

*Sales Engineer with Republic Flow Meters Co. From a paper presented at the Midwest Hotel Show.

AT LENAPE . . . WE PRESS-FORGE VESSEL ACCESSORIES IN

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Large High Type Nozzle with special saddle flange.

POWERFUL, slow, steady, controllable action of hydraulic pressing and forging permits the forming of metals into shapes best suited to each application—with ideal grain orientation and freedom from shatter cracks and severe distortion strains.

Seamless Manhole Necks furnished in many oval and elliptical sizes.

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Chrome iron condenser heads with integral Nozzles.

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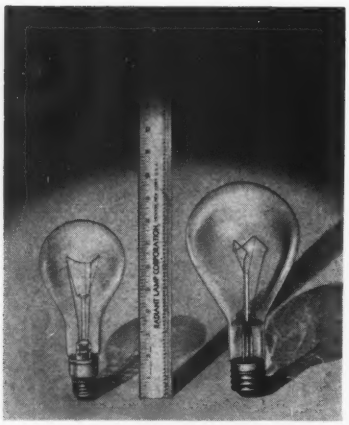
New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Industrial Lamps

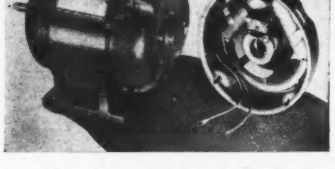
NEW TYPE high-wattage lamp made by Radiant Lamp Corp., Newark, N. J., will enable industries working on the defense program to increase illumination up to 250 percent with usual fixtures. Use of a hard glass bulb has made it possible to reduce the size of a 500 w. lamp to



that of an ordinary 200 w. lamp, also permits the lamp to withstand thermal shocks when used outdoors. The hard glass Radiant Lamp is said to withstand sudden shocks of rain or sleet without cracking. Other size industrial lamps up to 10,000 w. are now being made to meet special requirements in various industries.

Capacitor Motor

AS AN EXTENSION of its line of new polyphase induction motors, General Electric now offers a Tri-Clad capacitor motor to meet varied industrial applications. This new motor may be obtained



with either ball- or sleeve-bearing construction, in two types, Type KC, designed particularly for moderate starting torques such as fans, blowers, and centrifugal pumps; and Type KCJ, designed for applications requiring high starting torque. Capacitors are mounted inside the end shield on the normal-torque motor, while on the high-starting torque motor, 1½-hp. and larger, they are mounted in a compact case on top of the motor frame.

Both forms incorporate complete mechanical protection through the use of a cast-iron frame; electric protection by the use of Formex wire in the magnet coils; improved bearing design and lubricating arrangements, cast-aluminum rotor and double-end ventilation.

Transfer switch, from the starting to running connection, consists of a centrifugal mechanism mounted on the rotor shaft, and a stationary switch located in the end shield, which as the motor approaches full speed, moves the collar of the rotating mechanism away from the switch by snap action.

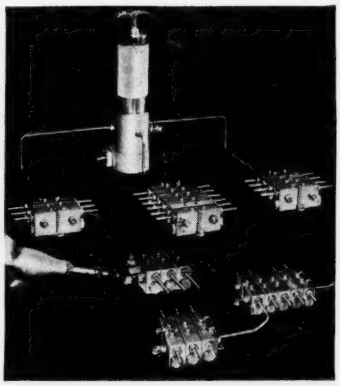
Master Controller

SPEED UP of production, through reduced fatigue, is claimed for the new line of cam-operated, mill duty controllers by Cutler-Hammer, Inc., Milwaukee, Wis. Ease of operation with positive feel of all speed positions is obtained by an adjustable compression-type of star wheel spring. The controller is available in two-speed, three-speed, and multi-speed types, for mill auxiliaries, crane hoist, bridge, and trolley applications.

Outstanding features are vertical contacts, double break, silver to silver; cam shaft operates on ball bearings sealed against dust; easily accessible terminal board simplifies installation and service; a heavy cast case and cover, for either separate or bench board mounting, provide protection from dust and mechanical injury. Spring return; off position latch, two, three, or five speeds are optional.

Lubrication

TRABON ENGINEERING CORP., Cleveland, O., announces the new Trabon Single pipe system, which it is said for the first time makes positive forced feed centralized lubrication almost universally applicable. This improved feeder (or distributor) consists of a bank of three or more sections, each of which discharges a known and measured quantity of lubricant alternately through one or two discharge outlets which are direct connected to bearings. The capacity or volume of the different sections of the same distributor may vary from 0.005 to 0.035 cu. in.



By selecting the proper number and capacity of sections, a single distributor discharging progressively through one outlet after another will deliver just the desired amount of lubricant to all bearings even though the individual bearings have widely varying lubricating requirements. The distributors can use either oil or grease as a lubricant.

A distributor, fitted with a simple pressure lubrication fitting, can be mounted on a machine and all the connected bearings positively lubricated manually with a simple hand or "gat" gun. Also, the distributor can be fed from a discharge outlet of another distributor, or from a metering feeder of a Trabon reversing system.

The new Trabon Series "MP" multi-outlet pumps, designed specially for use with these non-reversing systems, are available in three sizes having different reservoir capacities.

Reported recently by the B. F. Goodrich Co., Inc., Akron, Ohio, uses for Vibro-Insulators have been applied to oil burners, air conditioning units, blowers, marine engines, refrigerators, air compressors, vibrating screens, airplane instruments, broaching machines, fans, washing machines, mechanical phonographs and electromatic typewriters. The company also reports that new applications of the vibration eliminating devices are constantly being made.

"TWO WAYS to keep your Lines and Pumps FREE FROM SCALE"

It's no fun to take down your pumps, feedwater heaters, valves, and feed lines to clean out scale and encrustation. What's more, it's an expensive, time-consuming job.

You can prevent scale deposits in your pumps, feed lines, and other equipment with Dearborn Water Treatment. The sodium hexametaphosphate and organic reagents in Dearborn Treatment act chemically to prevent this precipitation. Dearborn formulas are also balanced to give full protection against pitting and corrosion and to reduce the possibility of steam contamination.

In over 8000 plants, Dearborn Treatment and Engineering Service has been giving complete satisfaction for many years. This individualized service is the result of years of experience and laboratory research and is engineered to fit the special operating conditions encountered. See your Dearborn representative.

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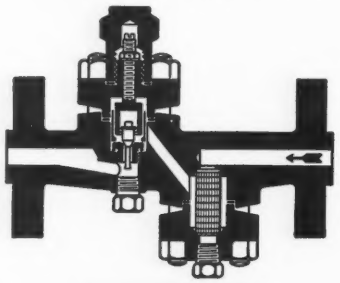
WATER TREATMENT and Engineering Service

CHICAGO • NEW YORK • LOS ANGELES • TORONTO and PRINCIPAL CITIES

Superpressure Steam Trap

YARNALL-WARING Co., Chestnut Hill, Philadelphia, Pa., announces the Yarway Impulse Steam Trap in a Superpressure type for high-pressure, high-temperature service in steam power plants.



SUPERPRESSURE TYPE

This trap is of high-pressure, flanged-end (or welding socket end) bolted-bonnet design, with integral strainer, with opening and closing of the valve governed by changes in pressure in the control chamber above valve piston.

The Superpressure Trap is built for steam pressures up to 1500 lb. and temperatures to 900 deg. F., pulsating or varying pressures not interfering with the operation.

Although capacities are ample for large amounts of condensate, the trap will also handle relatively small amounts of high-temperature condensate and closes positively in the presence of wet, saturated or superheated steam.

Return Idler for Belt Conveyors

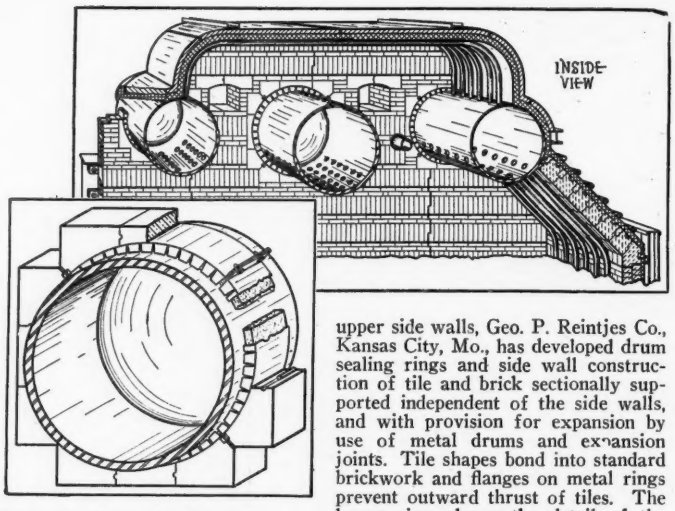
RUBBER-TREAD idlers for supporting the return run of 14 to 60 in. wide belt conveyors are announced by Link-Belt Co., Indianapolis, Ind. Each complete idler consists of from four to twelve 6-in. diameter rubber-tired rolls suitably

spaced and mounted on a Friction Fighter roller-bearing-equipped steel tube that will fit into the same supporting hangers as the regular Link-Belt return idler roll. The new idlers are especially recommended for conveyors handling corrosive, abrasive, wet, or sticky materials, such as salt, coke, phosphate rock, fertilizers, wet coal, etc.

Magnetic Gage

THICKNESS of sheet metal can now be measured from one side, by a new magnetic gage introduced by W. E. Abbott and B. M. Smith of General Electric engineering laboratory, with accuracy to 1/1000 in.

It is a 7-lb. unit to be connected to an electric outlet, creating a magnetic field to saturate the metal, readings being in proportion to the magnetic reluctance offered, which varies with thickness of material. Guarding against excessive thickness of sheets is important, since sheet metal is purchased by weight. The initial laboratory instrument has two scales; for 0.02 to 0.045 in. for low carbon steels; for 0.01 to 0.025 in. for electrical steels of medium silicon content. Portable gages can be made to measure up to ¼ in. thickness and stationary equipment for greater thicknesses.



Sealing Boiler Setting Tops

FOR SEALING the settings of water-tube boilers against air infiltration in the upper side walls, Geo. P. Reintjes Co., Kansas City, Mo., has developed drum sealing rings and side wall construction of tile and brick sectionally supported independent of the side walls, and with provision for expansion by use of metal drums and expansion joints. Tile shapes bond into standard brickwork and flanges on metal rings prevent outward thrust of tiles. The lower view shows the detail of the sealing rings, the upper view the application to the side walls of a bent tube border. The relation of the tile shapes and standard brickwork are clearly shown.

Simplified Small Electric Arc Welder

SIMPLIFIED welding is claimed as the outstanding feature of a new a.c. electric arc welder recently announced by the Ideal Commutator Dresser Co., Sycamore, Ill. The design includes a reactance winding on a separate core in addition to the transformer, which winding acts as a stabilizer, making it easy to strike an arc and hold it. As the distance from the end of the welding rod varies, this reactance winding causes the voltage to vary proportionately, so that the arc is always smooth.

Fifteen different welding heats between 20 and 175 amp. at 45 or 70 v. give the operator accurate heat and penetration control, up to ¼ in. or more.

The standard welder is for 230 v., 60-cycle operation, with welding rod recommended 1/16 to 5/32 in. Primary current 1.75 amp. no load, 52 amp. full load. Accessories available with the Weld-Master include ground lead, electrode lead, electrode holder, welding rod, primary cord and plug.

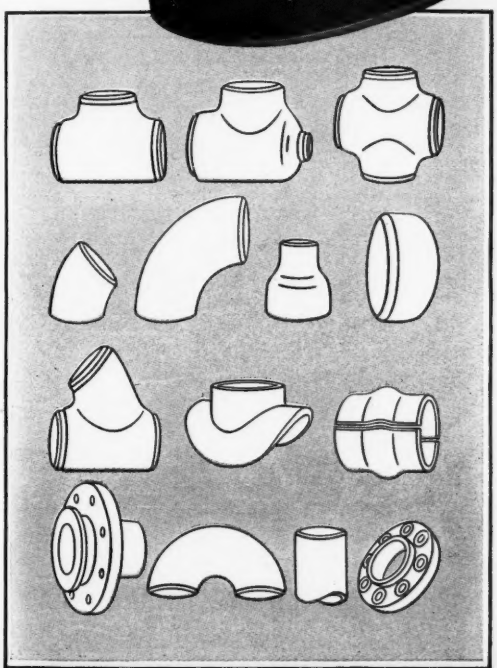
Tight Fitting, Hand Operated Butterfly Valve

R-S PRODUCTS CORP., Philadelphia, Pa., announces a hand-wheel operated design of the improved butterfly valve in which internal parts are machined to assist operation and to obtain a tight fit between housing and vane, in standard

sizes from 2 to 48 in. for working pressures up to 15 p.s.i. Adjustable stops are provided to stop the vane in either of two set positions between "open" and "closed", which permits duplication of any set maximum or minimum opening, in addition to full-open and tight-closed, valves having a graduated dial and pointer for showing position of the butterfly vane.

Assembly for hand-wheel, hydraulic or motor operation is through a self-locking worm and quadrant so arranged on the side of the housing that the wheel can be located in the most convenient position.

Ashcroft Gauge Division of Manning, Maxwell & Moore, Bridgeport, Conn., announces a new and streamlined package for its recent line of streamlined gauges, which have the same dial sizes as the older type, but of greatly improved appearance and reduced overall size. The trim, new packages are much more convenient for storing and handling.



MIDWEST

WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

(See New Bulletin WF-41)

MIDWEST REDUCING Butt-Welding Elbows

The Reducing Butt-Welding Elbow has recently been developed by Midwest to meet a need that has existed for a long time. In a pipe line where it is necessary to change both direction and pipe size, this reducing elbow takes the place of two welding fittings: (1) a straight elbow and (2) a reducer. The result is the elimination of one or two welds, saving in erection time and expense, and an improved appearance.

For complete information regarding Midwest Reducing Elbows, see the new Midwest Welding Fittings Bulletin WF-41 (now available from nearest office or distributor).

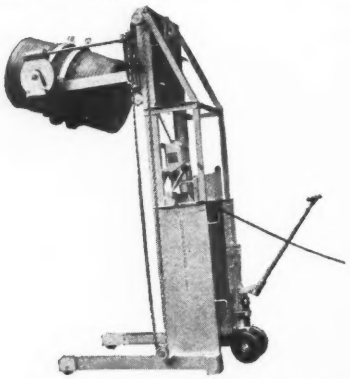
MIDWEST PIPING & SUPPLY COMPANY, Inc.

Main Office: 1450 So. Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • Sales Offices: Chicago—949 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • San Francisco—426 Call Bldg. • Tulsa—533 Mayo Bldg.

Drum-Dumping Stacker

ANNOUNCED recently by the Lewis-Shepard Sales Corp., Watertown, Mass., is a newly improved drum-dumping stacker, which handles the dumping of drums, barrels and liquid or dry materials containers.

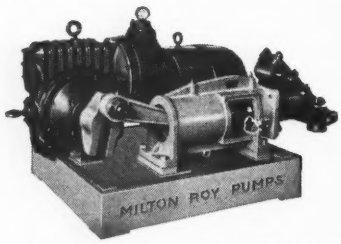


This development permits control of the dumping operation by the operator from the floor.

A self-locking worm makes it possible to hold the drum at any position, while control from the floor permits reversing the tilt of the barrel to slow down or stop the flow of material.

Step-type Valve for Pumps

IMPROVED type of step-valve has been announced by Milton Roy Pumps, Philadelphia, Pa., which makes the entire interior of the valve body accessible for cleaning by the removal of a single, flat, cover-plate without dismantling the piping. It is stated that this valve will automatically discharge all air and eliminate air-binding, also all small particles of dirt.



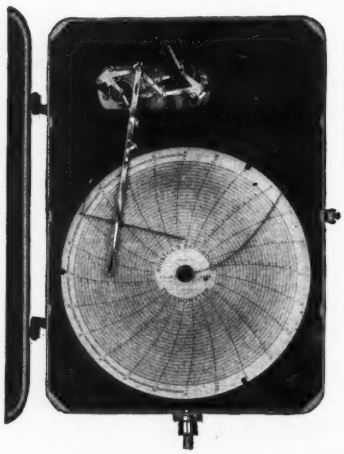
Accompanying illustration shows the new construction on a pump for 1200 g.p.h. against an operating pressure of 100 p.s.i. at 86 strokes per min. with driving motor 7½ hp. All parts in contact with the solution being pumped, including double ball-checks, seat and piston, are of acid bronze. The stroke is readily adjusted to change the capacity of the pump from zero to maximum.

Bearing Greases

GULF OIL CORPORATION, Pittsburgh, Pa., has developed two new lines of lubricating greases for ball and roller bearings, which are the result of a number of years of research by the company's technologists. Gulf Anti-Friction Grease is recommended for heavy duty service, and Gulf Precision Grease for lighter duty and higher speeds. With high melting point and prepared for greatest resistance to oxidation and separation, they are prepared by a newly developed method of compounding, employing special high pressure kettles and mixing methods, to give smooth, non-fibrous texture. Both lubricants are available in a wide range of consistencies recently recommended by the National Lubricating Grease Instituite for any method of application or operation condition.

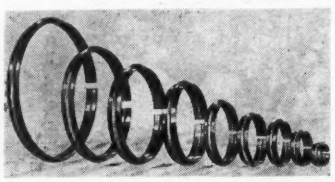
Recording Thermometer

THE BRISTOL CO., Waterbury, Conn., has developed two new recording thermometers of the liquid filled type, to be known as Class I, one being case-compensated, the other fully-compensated. The case-compensated instrument is offered in temperature ranges up to 400 deg. F. and tubing lengths up to 10 ft. or longer, depending on conditions surrounding the installation. The fully-compensated thermometer may be had in ranges up to 400 deg. F. equipped with 200 ft. or less of connecting tubing between instrument and bulb. These thermometers are said to give uniformly accurate results over a wide range of change in temperature along the tubing and in the case. The measuring systems of these thermometers are also used in the Bristol Free-Vane Air-Operated Temperature Controller.



Welding Rings

AS A RESULT of several years' development by laboratory and field tests, Tube-Turns Inc., Louisville, Ky., is offering welding rings for use with all types of Tube-Turn welding fittings and straight pipe. These are carefully designed to assure perfect, full strength joints, to eliminate human hazard element in welding and to speed up the welding process in both arc and gas methods by simplifying lining up without clamps, guides or fixtures for supporting pipe and fittings when tack welding.



Center Drive Scrugun

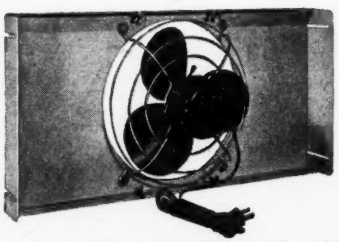
VAN DORN Electric Tool Co., Towson, Md., has developed its No. 8 Center-Drive Scrugun for operation in a suspended position with the bonnet grip or paddle switch arrangement which eliminates handles. When equipped with reversing switch, it will operate in reverse at full power. It is available with either positive or adjustable clutch, and with either bonnet grip and toggle switch or paddle switch. Capacity for driving wood screws up to No. 10 by 2 in., self-tapping screws up to No. 12, and machine screws and nuts up to ¼ in. diameter. No-load speed is 750 r.p.m. with optional speeds available for 500, 1000, and 1250 r.p.m.

Cubicles

FACTORY-BUILT switchgear cubicles of steel are installed with considerable saving in time and floor weight over building concrete compartments. For a group of 22 General Electric cubicle units, a comparable concrete installation would require more than 154 t. of concrete for the circuit breaker cells and bus compartments. Weight of the concrete structures alone would exceed the total weight of the steel cubicles, including switchgear, by more than 44 t. These cubicles are shipped assembled and installed, consisting of placing the units in position side-by-side, joining the buses and connecting the terminal leads.

Ventilator

A NEW wall-box and window-panel ventilator, completely redesigned, has been recently announced by Wagner Electric Corp., St. Louis, Mo.



The ventilator panel is adjustable from 23 to 36 in., having a single-speed fan which delivers 560 c.f.m. It also has quiet-type blades, and an induction type motor.

Airfoil sections used in modern airplane wings are, in principle, being commercially applied to deep well and propeller pumps, according to an announcement by the Peerless Pump Division of the Food Machinery Corp. The airfoil principles adapted to the propeller vane sections have been thoroughly and successfully applied to deep well applications. The specific advantages include higher efficiencies and better pump life. While the thicker vane sections increase first cost somewhat, the improvement in performance and life, in the opinion of the manufacturer, warrant this increase many fold in higher prolonged efficiency.

YOU *Save* BY STANDARDIZING ON CRANE No. 7's

for

- STEAM
- HOT WATER
- COLD WATER
- AIR
- OIL
- GAS
- GASOLINE

These 150-pound multi-purpose valves save you time and money . . . in extra service . . . quick repairs . . . simplified purchasing. Made of heavy brass—with renewable disc in slip-on holder. Available with composition discs for various services. A supply of discs and extra holders permits quick disc renewal or conversion for other services. In globe and angle patterns.

For dependable and economical flow control in every service, look to the great Crane line of over 38,000 valves and fittings. There's a Crane Branch or Wholesaler nearby —with ample stocks to serve your needs.

CRANE

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO, ILL.

RANAREX*

the only *mechanical* CO_2

INDICATOR and RECORDER

FAST

Accurate readings (within 3/10 of 1% CO_2) in 30 seconds.

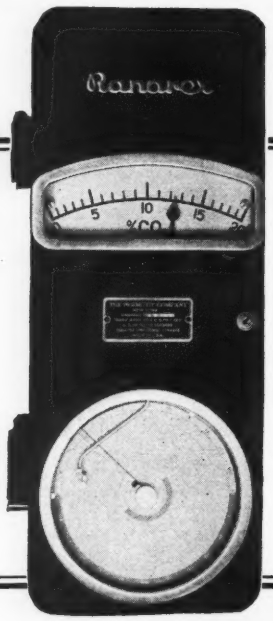
TOUGH

No chemical or fragile parts to get out of order. Operates on lighting circuit.

ECONOMICAL

Big savings on fuel costs reported by users—as high as 20%.

Write for free booklet giving complete description of this amazing instrument. Address The Permutit Company, Dept. A1, 330 West 42nd Street, New York, N. Y. *Trademark Reg. U. S. Pat. Off.



product of **PERMUTIT**

Commutator Burnisher

A NEW development for removing film on commutators has been announced by the Ohio Carbon Co., Cleveland, Ohio,

and is of special material, mounted in a wooden handle, to be held against the commutator while running. It is made in sizes up to 20 in. long.

Check Valve

JENKINS BROS., New York, N. Y., announces a new regrinding Swing Check Valve for 125 lb. steam pressure at 500 deg. F. or 250 lb. non-shock cold for oil, water, gas. This valve, which permits full flow practically equal to that of the pipe, is suited for condensate and return lines as well as for feed and oil line service. Disc can be reground without removing the valve from the line. Body is provided with ribs which give a firm grip for either a Stillson or a monkey wrench. Made in sizes ¼ to 2 in. inclusive.

Liquid Rubber

NONSLIP PULLEY Covering Co., Buffalo, N. Y., recently announced a new product known as Nonslip Rubberpull. This product is supplied in liquid form, readily applied with a brush to the face of any pulley for the purpose of preventing belt slippage. The product has a rubber base and is so compounded that it sticks to the pulley face regardless of the pull exerted upon it. It can be applied in a few minutes' time at the end of the day, and pulleys will be ready for use the next morning.

Packing

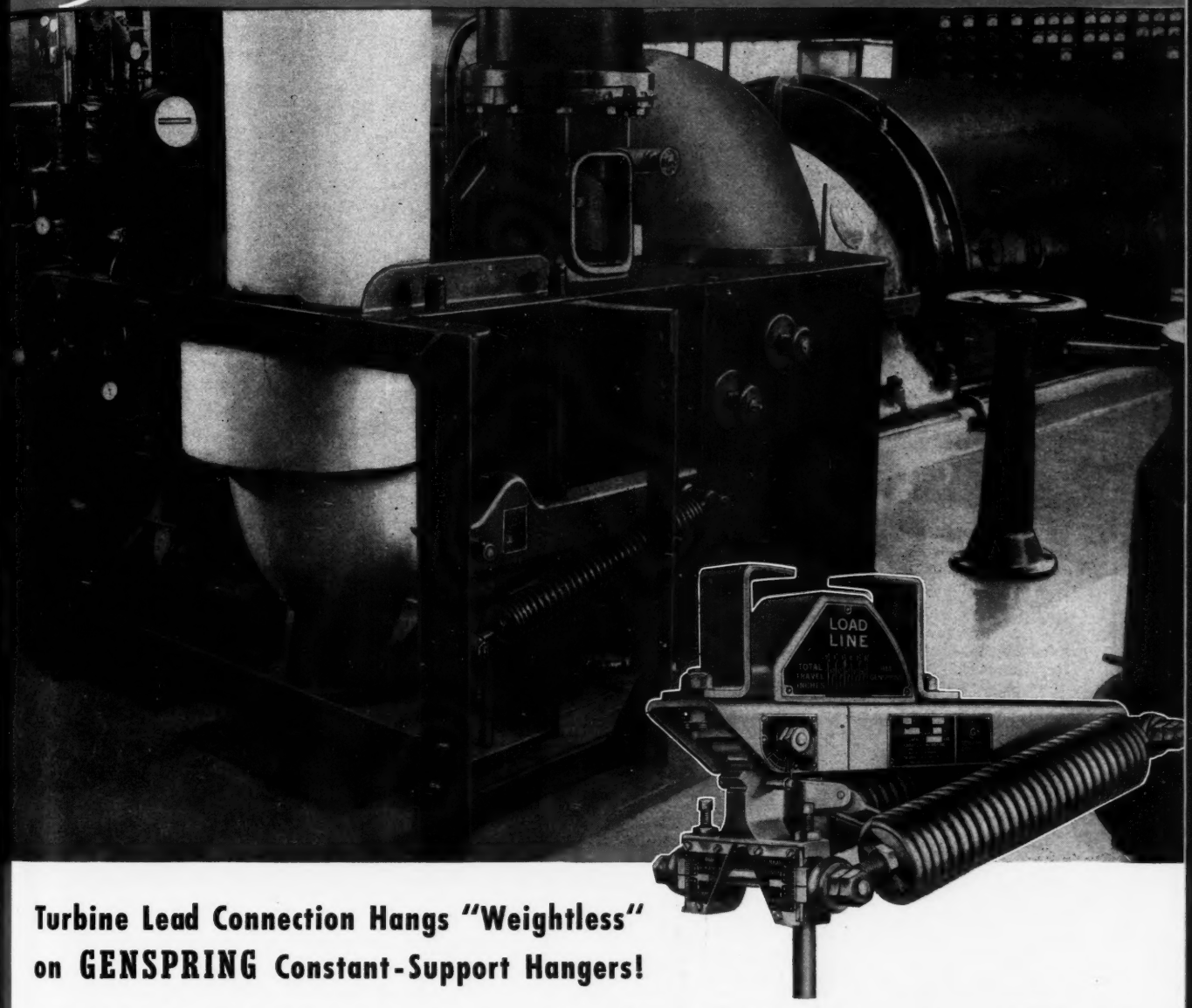
HIGH-PRESSURE Palmetto spiral packing announced by Greene, Tweed & Co., New York, N. Y., is now available with the outer layer impregnated with Palmetto graphite grease forced into the packing by a special hot pressure process. The packing is of closely-woven asbestos cloth with center block laid up against a flat strip of heat-resisting resilient red rubber, the wear face being firmly bonded to the center to make a strong square-cornered packing. The packing is spiraled on a mandrel and vulcanized so that it retains its shape, and the lubricating process is then applied. This packing is adapted for reciprocating rods and plungers of steam engines and pumps, air and gas compressors, and various special machinery. It is furnished in standard 12½ ft. spirals.

Insulation

ANNOUNCED recently by Asbestos Limited, Inc., New York, N. Y., is New Era Insulation, prepared by a special process of expanding asbestos fibre, which gives it extraordinary lightness and unusual insulation value.

Weighing 11 lb. per cu. ft., this insulation is equally suitable for low and high temperatures. It is manufactured in flat blocks, segmental form and in sectional covering of all standard sizes and thicknesses and may be used in insulating boilers, breechings, tanks and other installations where temperatures do not exceed 500 or 600 deg. F., as for pipes, furnaces, and other equipment where temperatures reach 1600 deg. F.

Floating
2" FROM THE FLOOR!



Turbine Lead Connection Hangs "Weightless" on GENSPRING Constant-Support Hangers!

Here is just one example of the many important opportunities for improvement in power piping now made possible by Grinnell GENSPRING Constant-Support Hangers. In the installation pictured above, a complete high-pressure turbine lead connection literally *floats* in perfect balance . . . free from usual added stresses caused by weight and motion!

WRITE FOR NEW DATA BOOK containing full details of GENSPRING Constant-Support Hangers and instructive information to help solve problems of power piping *travel.*

Unlike old-style, variable-support hangers, GENSPRING Hangers accurately and sensitively balance the weight of pipe in every "hot" and "cold" position. Their patented non-resonant mechanism eliminates the weight-stress due to thermal movement . . . helps to absorb vibration . . . effectively increases safety factor of the entire piping system!

Investigate this original constant-support hanger for high-pressure piping in your power plant. Only GENSPRING Hangers give this precision-balanced suspension! Made to support loads from 250 to 8500 pounds. Grinnell Co., Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

GENSPRING CONSTANT-SUPPORT HANGERS BY

GRINNELL

WHENEVER **PIPING** IS INVOLVED

"Reduced Our Coal Bill from $4,000 to $2,500 Annually"

FYR-FEEDER Facts:

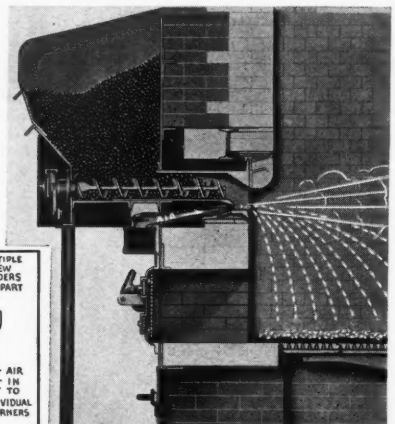
1. **BURNS CHEAPEST COAL.** Excellent combustion with virtually any type of coal. Typical users report savings of $2.00 to $4.00 per ton by using screenings, yard sweepings, local coal, etc.
2. **UNEXCELLED DEPENDABILITY.** Even in small, low cost FYR-FEEDER installations you can have *two* separate burners, each with its own air nozzle and coal delivery screw. Danger of fire going out ceases to be a menace. Clogging due to wet or damp coal, even with smallest sizes, is also virtually unheard of with FYR-FEEDER'S positive mechanical delivery of coal to inside of furnace.
3. **ALWAYS NEAR PEAK EFFICIENCY.** The individual FYR-FEEDER burners are adjusted to give you peak efficiency. Very light loads can be handled with little dimunition in net efficiency.
4. **IDEAL FOR MODERNIZATION JOBS.** Ability to fit in with your present equipment and to deliver modern firing efficiency with lower capital investment has already made FYR-FEEDER a favorite!
5. **ADVANCED MECHANICAL FEATURES.** No fast-moving mechanical parts in contact with coal. No high speed parts subjected to radiant heat of furnace. Independent multi-burners provide high factor of safety against mechanical failure.
6. **INDIVIDUALLY ENGINEERED TO FIT YOUR BOILERS.** Our Engineering Department will work with your Consulting or Operating Engineer to give you the most efficient installation possible. A drawing is made for each FYR-FEEDER job and each installation is supervised by a competent engineer.
7. **HIGH QUALITY CONSTRUCTION.** We will be glad to supply you with detailed information about FYR-FEEDER units. Write today. The coupon below is for your convenience.

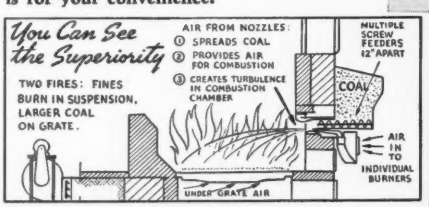
—writes
CLARENCE M. SIEBEN,
Chief Engineer,
SIEBEN'S BREWERY CO.
Chicago, Ill.

From letter: "Your FYR-FEEDER system of burning cheap coal, installed under one of our 250 H.P. boilers and replacing an underfeed type of stoker, has reduced our coal bill from $4000 to $2500 annually.

"This annual saving of $1500 not only exceeded your own estimate, but permitted us to pay out our investment in the FYR-FEEDER in about 18 months after it was placed in service. We now burn yard sweepings, also the smaller, cheaper sizes of coal ranging from $1.50 to $2.00 less per ton than the coal required by our former method of firing; also, we now automatically maintain uniform steam pressure under all loads, and the FYR-FEEDER gives us higher efficiency, in addition to the direct saving in the price of coal."

—A 74% Return on the Investment!




You Can See the Superiority
AIR FROM NOZZLES:
① SPREADS COAL
② PROVIDES AIR FOR COMBUSTION
③ CREATES TURBULENCE IN COMBUSTION CHAMBER
MULTIPLE SCREW FEEDERS 12" APART
TWO FIRES: FINES BURN IN SUSPENSION, LARGER COAL ON GRATE.
COAL
AIR IN TO INDIVIDUAL BURNERS
UNDER-GRATE AIR

Fyr-Feeder Multi-Burner SPREADER STOKERS

AMERICAN COAL BURNER COMPANY
FOUNDED 1916
Builders of thousands of over-feed stokers

AMERICAN COAL BURNER CO., 153 E. Superior St., Chicago, Ill.
☐ Please mail descriptive literature.
☐ Quote me cost estimates on a FYR-FEEDER for a .....h.p. boiler.
☐ Have salesman call.

Name.....
Company.....
Street.....
Town.....State.....

Flexible Coupling

FALK CORP., Milwaukee, Wis., announces a new type of flexible coupling, the Airflex, especially designed for connecting Diesel, oil, gasoline, or gas engines to any type of driven machinery, in which the degree of resiliency can be readily changed to suit the exact requirements of a particular application. It has a resilient rubber gland lined with a cylindrical section which is covered with layers of tough durable fabric and live rubber, and is permanently bonded to rugged steel inner and outer rims. The gland is inflated to proper pressure and the degree of elasticity can be varied by changing the air pressure. Six standard types are available: Both hubs external; one hub inverted; for equipment having flywheel on driving or driven shaft; with thrust unit for marine propulsion; high speed type; disconnecting coupling.

Condensation Collector

RECENTLY developed by J. W. Mortell Co., Kankakee, Ill., is Insulmat No. 595, a spray-on plastic compound, containing specially treated cork particles and said to possess unusual adhesion. It is odorless and forms a protective coating to metals which eliminates condensation drip. Insulmat is also self-bonding, requires no priming coat and can be applied to any metal surface.

Spectrographic Photometer

RAPID and precise means of studying spectographic plates is provided by a new photometer designed by J. T. M. Malpica and W. R. Fanter of the General Electric Co. general engineering laboratory at Schenectady. Spectrographic analysis, which involves the burning of a sample by means of an arc or spark and recording the spectrum on a photographic plate, is one of the most favored means of checking the correctness of metallic mixtures in the course of important casting operations. The photometer, therefore, is regarded as a valuable tool in national defense work.

It is particularly useful in the control of the manufacture of alloys for turbines and generators, and all kinds of castings. The instrument enlarges the spectral lines approximately 20 times and provides a means of determining their intensities by measuring the light passing through them to a photoelectric cell. From these data, the concentration of the constituents of the alloy is determined.

The equipment is arranged to operate on a 6 v. supply of either direct or regulated alternating current.

Warren Pulley Cover Co., Danielson, Conn., announce a special pulley covering or compound to eliminate slip of belts on pulleys. This is applied by brush, and on drying gives an adhesive but not sticky surface said to be adequate for 1 or 2 yr. wear.

Portable water tester for analysis for hardness, alkalinity, and various impurities is announced by Betz Laboratories, Philadelphia, Pa. Apparatus, chemicals and a fluorescent light are compactly arranged in a wooden cabinet, which is provided with a duck cover. It is known as the M Test Kit.

NOW

1. COMBINED TRIP AND THROTTLE VALVE
2. READILY ACCESSIBLE STEAM STRAINER
3. IMPROVED BEARING COOLING
4. NEW SPEED-REGULATING GOVERNOR
5. INCREASED CAPACITY RANGE IN ALL SIZES

MECHANICAL-DRIVE TURBINES WITH POSITIVE OVERSPEED PROTECTION

YOU can now be sure of positive protection against overspeed—because an emergency trip device operates a built-in combined trip and throttle valve to shut off *all* steam flow should overspeeding occur. It's an added safeguard—*positive overspeed protection.* It's available as a standard feature. If for any reason speed becomes excessive, the emergency trip device takes charge to instantly close the inlet valve. During normal operation the turbine speed is controlled by a centrifugal-weight governor or, if desired, a pressure regulator. A Monel-metal, basket-type steam strainer around the valve prevents entrance of foreign materials into the turbine and assures positive valve operation at all times.

Efficient, dependable, economical, these improved Type D turbines are just the drive for pumps, fans, compressors, generators, and paper machines. Get all the facts and you'll get "G-E." General Electric Co., Schenectady, N. Y.

Bulletin GEA-3557 tells more. Write for your copy today. General Electric, Schenectady, New York.

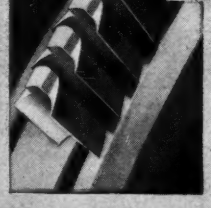
A TURBINE FOR EVERY APPLICATION

THREE TYPES RANGING IN CAPACITY FROM 5 TO 2000 HP AND IN SPEEDS FROM 1000 TO 5000 RPM

D-114	Steam inlet diam. 3 in.; outlet diam. 5 in.
D-120	Steam inlet diam. 4 in.; outlet diam. 8 in.
D-125	Steam inlet diam. 5 in.; outlet diam. 10 in.

1. **COMBINED TRIP AND THROTTLE VALVE** with trigger action assures positive overspeed protection. Hardened steel trigger and trigger blocks hold heavy spring in compression until tripped by action of overspeed governor. Combination valve with resetting hand wheel for use in starting makes unnecessary a separate shut-off valve between turbine and station piping.
2. **READILY ACCESSIBLE STEAM STRAINER** located in steam chest protects throttle valve, governor valve, nozzles, and buckets. Basket-type perforated Monel metal strainer is made accessible for cleaning by lifting valve bonnet.
3. **IMPROVED BEARING COOLING** lengthens oil life. Enlarged cored water passages envelop the oil reservoir, providing ample circulation of water.
4. **NEW SPEED-REGULATING GOVERNOR** of improved design controls admission of steam to regulate turbine speed, which can be varied easily while turbine is in operation. Low-friction bushings reduce inertia of moving valve stem for accurate and quick-responding speed control.
5. **INCREASED CAPACITY RANGE IN ALL SIZES** for greater flexibility and economy in selection of turbine drives.

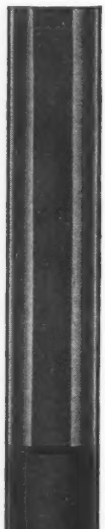
Substantial nozzle plate with ports reamed in a solid block of steel efficiently directs the initial flow of steam. Stationary blades securely anchored to nozzle plate with dove-tail fastening.



Selected material and proper blade angles assure long life and high efficiency. Buckets, either milled or forged, are of chrome-steel alloy—a material selected for its strength and resistance to corrosion.

GENERAL ELECTRIC

Visibility PLUS THRIFT



WHEN you install "PYREX" Broad Red Line Gauge Glasses, you are not only obtaining maximum liquid level visibility, you are cutting gauge glass costs to the bone.

Years of actual service prove that "PYREX" Gauge Glasses last longer because:

1. Their machine drawn accuracy minimizes breakage due to installation strains.
2. Resistance to thermal shock makes them proof against sudden temperature changes.
3. They are fully capable of withstanding the maximum working pressures for which they are recommended.
4. "PYREX" Gauge Glasses resist the corrosive action of steam and remain clear and unclouded over long periods.

For visibility plus thrift, install "PYREX" Gauge Glasses. They are stocked by leading mill and steam supply dealers.

"PYREX" is a registered trademark and indicates manufacture by Corning Glass Works.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

The Indispensable Tool

During the last sixty years the use of mechanical power in industry has increased more than fourfold per worker and the output per worker has increased more than fivefold. A large part of this progress has been due to the use of advertising as a means of telling industry about the improved ways of generating and utilizing power. The machine age means better equipment for more plants and workers, and advertising is its indispensable tool.

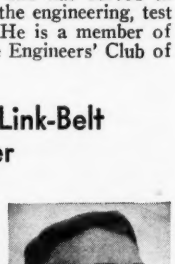
MANUFACTURERS' PERSONALS

C. E. Co. Promotes Walker and Ebdon

DONALD S. WALKER, for several years past General Sales Manager of Combustion Engineering Co., Inc., was named Vice President in Charge of Sales at a meeting of the Board of Directors on April 11. Mr. Walker is a graduate of the U. S. Naval Academy, Class of 1924, and for the next 10 yr. was associated with D. H. Skeen & Co. of Chicago, in charge of Ljungstrom Air Preheater sales, becoming vice president of that company and subsequently president of its subsidiary, the Mercon Regulator Co. He joined Combustion Engineering Co. in December, 1934, as manager of the Philadelphia District. Among the engineering societies of which he is a member are the A.S.M.E., the Society of Naval Architects & Marine Engineers, the Iron & Steel Institute and the Army Ordnance Association; also the Engineers' Club of New York.

H. G. Ebdon, formerly Assistant General Sales Manager, has been advanced to General Sales Manager to succeed Mr. Walker. Receiving his technical education at Cooper Union and at Brooklyn Polytechnic Institute, followed by several years with the Consolidated Gas Company and the Wilputte Coke Oven Co., Mr. Ebdon joined Combustion Engineering Co. in 1917 and has served in various capacities in the engineering, test and sales divisions. He is a member of the A.S.M.E. and the Engineers' Club of New York.

Harry Strube Link-Belt Chief Engineer



LINK-BELT Co. announces that Harry L. Strube has been appointed chief engineer of the Link-Belt eastern division, with headquarters at the company's Philadelphia plant, to succeed F. F. Waechter, who has resigned after rounding out 43 years of service. Mr. Strube has been assistant chief engineer at Philadelphia, having begun his Link-Belt service in the engineering department of the company's Pershing Road Chicago plant in 1910. Subsequently he served as sales engineer, first at Chicago and then in Philadelphia. In 1924, he rose to the position of manager of vibrating screen sales, and in 1934, was made assistant chief engineer.

Appointment of G. A. Barker as manager of Johns-Manville's public utility and electrical products department is announced by L. R. Hoff, president of Johns-Manville Sales Corp.

(Continued on Page 122)

There's more to POWELL QUALITY than meets the BUYER'S EYE!

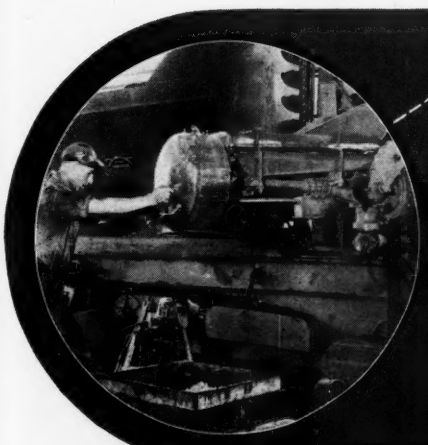
LARGE VALVES REQUIRE A SPECIAL SET OF QUALITY STANDARDS, SO LET'S INSPECT STEEL FOUNDRY PRACTICE IN THE MANUFACTURE OF POWELL LARGE VALVES

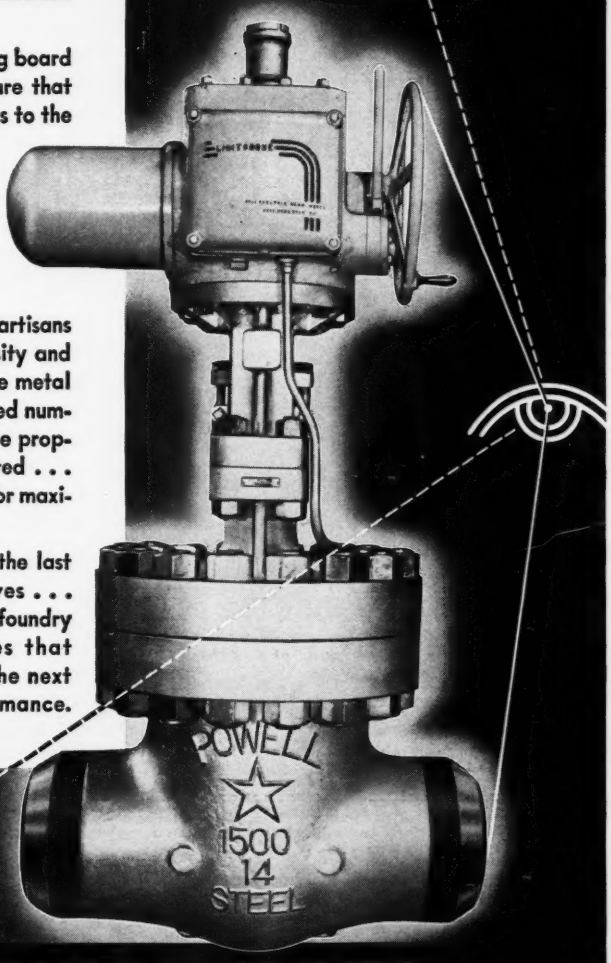
If a valve has to withstand pressures ranging into thousands of pounds . . . if the valve itself may weigh as much as six tons or more . . . then, to be sure, special standards of manufacture have to be followed.

From the first rough sketch on a Powell engineer's drawing board to the finished product, the self-same scientific procedure that distinguishes Powell valve manufacture in general applies to the huge steel and alloy valves needed for high pressure and high temperature service. Designs are checked and double-checked...materials are constantly laboratory tested for strength and durability . . . patterns are carefully made. Then, for the first actual building step —the casting.

Here in the Powell foundry, modern furnaces and skilled artisans combine to produce a valve absolutely free from porosity and sand inclusions. Every step is taken to insure quality. The metal is poured at a specified heat . . . a certain, pre-determined number of hours are allowed for cooling. Gates and risers are properly removed—casting is cleaned, then carefully inspected . . . finally, it's properly heat treated, according to analysis, for maximum physical characteristics and resistance to fatigue.

Then, on to the machining and testing departments for the last operations in the manufacture of large Powell valves . . . operations that verify the labors of the research and foundry departments, and put the final touch on valves that are *"quality through and through."* Consider Powell the next time you specify valves . . . buy value . . . buy performance.





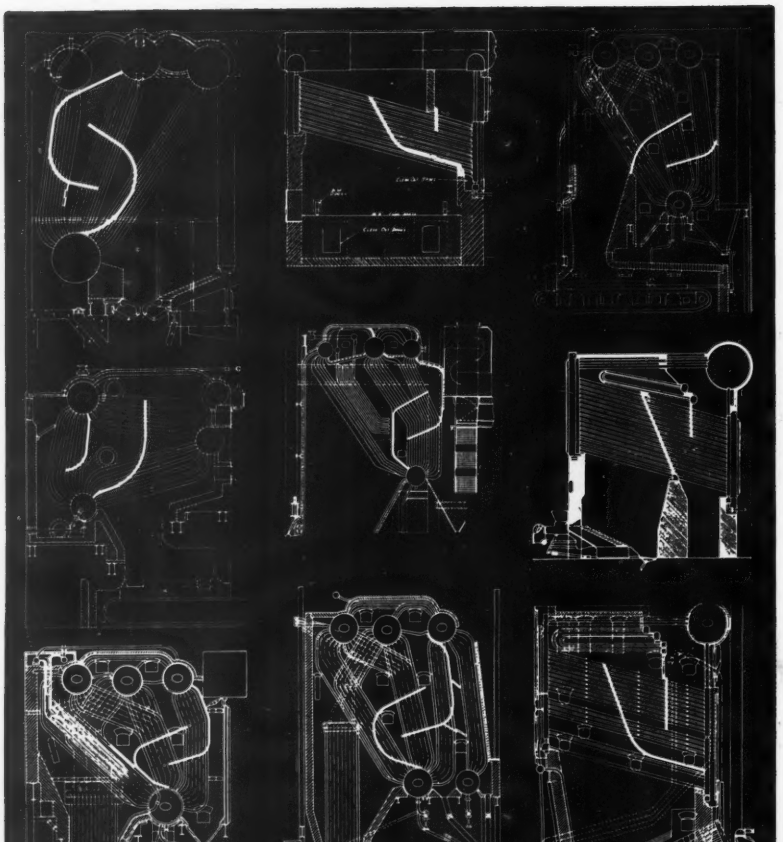
POWELL VALVES

THE WM. POWELL COMPANY • CINCINNATI, OHIO

You Need More Than a Photograph of the Finished Product to See ALL of the Qualities that Make Powell Valves Uniquely Able to Better Serve the Power Engineer

ADVERTISING PAGES REMOVED

Enco Streamline Baffles



YOU CAN INCREASE CAPACITY AND EFFICIENCY IN EXISTING OR NEW BOILERS

Installation of ENCO Baffle Walls in all types of water tube boilers has resulted in immediate improvement in performance, operation and maintenance.

Better heat distribution, maximum heat transfer to boiler and superheater surfaces, lower draft loss, lower flue gas temperatures and higher capacity are assured through ENCO design and construction. In addition, the smoothly curved surfaces of ENCO streamlined baffles tend to prevent fly ash and cinder accumulation, saving time and steam by making it easier for soot blowers to do a more thorough and efficient job of keeping heating surfaces clean.

ENCO Baffles, constructed gas tight with Enco Plastic, Tile and Reinforcement provide for expansion and assure extra strength. They may be built in desired locations assuring minimum disturbance when tube renewals are required.

Flexible design, the careful selection of materials and their installation by experienced mechanics result in a construction which can be depended on for long service under severe operating conditions.

TAKE ADVANTAGE OF ENCO SERVICE TO IMPROVE YOUR BOILERS

Send blue prints and operating data and ask ENCO engineers to submit suggestions. No obligation, of course. Ask for the new Enco bulletin BW 40—sent FREE on request and containing detailed engineering information on modern ENCO Baffle Walls for all types of water tube boilers. Write for your copy TODAY.

ENCO PATENTED BAFFLES ARE FURNISHED EXCLUSIVELY BY

THE ENGINEER COMPANY

75 West St., New York, N. Y.

Helpful Bulletins

BOILER PLANT EQUIPMENT

1 Boilers—Babcock & Wilcox Co. Bulletin No. G-28 describes Design 32 cross-drum, straight-tube, sectional header unit for pressures of 250 lb. or less, with heating surface from 1000 to 6000 sq. ft.

2 Furnace Draft—"Draft . . What, Where, How, Why" is the title of new publication No. 41-472 issued by The Hays Corp. It explains in plain language what draft is, how it is measured, what the draft guage tells the operator, where to measure draft in a modern steam generating plant and how to install draft guages under varying conditions. This should be a valuable handbook for operating or consulting engineers.

3 Furnace Jets—"There's Gold in Your Smoke Bank" is the title of a 12-page bulletin, in colors with cellophane cover, describing the application, advantages and installation of T-Z double injection steam jets for producing furnace turbulence, to give better burning of volatile gases, prevent soot and carbon formation and eliminate smoke. T-Z Railway Equipment Co., Inc.

4 Stokers — Canton Stoker Corp., 8-page bulletin No. 203 describes Vulcan heavy duty industrial ram underfeed stoker, showing assembly, cross-sectional views, material specifications and specification outline.

5 Steam Scrubber—Bradshaw & Co. 8-page bulletin describes W-K-M master steam scrubber. Purposes of scrubber are given, design presented, and questions and answers are asked and answered concerning operation and capacities of scrubber.

6 Boiler Blowdown — Haphazard blowdown of boilers has been replaced by simple but scientific methods which have resulted in more economical operation in many plants. Nalco Bulletin No. 21-B published by National Aluminate Corp. is devoted to this subject and presents different easy methods of maintaining blowdown control.

7 Self-Contained Boiler—Illustrated 8-page Bulletin SB-21 tells about Erie City Economic boiler with water cooled side walls. This self-contained, fire-tube boiler is shipped completely assembled. Bulletin contains dimension tables and installation photos. Erie City Iron Works.

8 Separators—Elliott Co. announces a new eight-page bulletin E-3 on Elliott separators. This bulletin briefly illustrates and describes steam, oil and receiver type separators, products which the Elliott Co. has been manufacturing for many years.

9 Oil Burner—An 8-page bulletin describes burner equipment and shows details and installations for ships, industrial plants and public buildings. National Airoil Burner Co.

10 Pneumatic Spreader Stoker—Just off the press is a unique bulletin describing the design and operating advantages of the Iron Fireman pneumatic spreader stoker. Jumbo color diagram pictures feeding and conveying coal, combustion in furnace, etc. Flat binder pages show typical stoker installations in various industrial plants. Iron Fireman Mfg. Co.

PRIME MOVERS

57 Diesel Engines — "Modernizing Your Diesel," a 12 page booklet shows how owners of Fairbanks, Morse Diesel engines can incorporate modernized features into their existing engines, with increase in efficiency and power. Fairbanks, Morse & Co.

58 Generating Sets—Bulletin No. 107, 32 pages, describes and gives performance data on Troy-Engberg generating sets. These modern units enable steam to do double duty—produce current and serve for process and heating. Troy Engine & Machine Co.

59 Diesel Power Units—More than a hundred typical installations of Caterpillar Diesel engines are photographed and discussed in a new 32-page booklet entitled "On the Job". Twenty specific classifications, and numerous miscellaneous installations are photographed and discussed. Caterpillar Tractor Co.

60 Turbine Drive — Catalog P-3616 describes application of De Laval turbine drive for boiler feed pumps and other jobs where turbine exhaust is used for feed heaters. De Laval Steam Turbine Co.

WATER TREATMENT

61 Water Treatment—Cyrus W. Rice Co. Booklet entitled "Silica vs. Phoscaloid" is story of development of phoscaloid and its use in lime-soda softening plants.

62 Water Cooling — New .Bulletin 40-A describes design and application of Pritchard "featherweight" noncorrosive fans for mechanical draft water cooling towers; also retriever type drift control in atmospheric cooling towers, and other features. J. F. Pritchard & Co.

63 Water Problems—March issue of the H-O-H Lighthouse, issued quarterly by D. W. Haering & Co., Inc., features Cuba and the solution of water problems in this progressive Republic. Descriptions of several Cuban institutions which are using modern methods for combating scale formation and corrosion in water systems are presented. Included is a discussion of the principles of oxygen removal by Sulpho Glucosates and the control of corrosion in this manner.

64 Water Treatment—Cochrane Corp. 48-page catalog No. 3000 on hot-process water softeners for removal of silica, etc., from boiler feedwater. Contains 9-page appendix of feedwater chemistry, in addition to heat balances, flow diagrams, construction drawings, engineering tables and charts.

65 Water Analysis — 20-page Water Analysis Manual contains complete facts on water analysis by authorities. Tells how to obtain representative samples and follows through with correct procedure and calculations of results for each test. Chemicals required enumerated, and apparatus illustrated. W. H. & L. D. Betz.

MISCELLANEOUS

66 Engineering Instruction—"Looking Ahead" is the title of a helpful bulletin outlining the courses offered by International Correspondence Schools. Special chapters cover work in combustion and steam engineering, internal combustion engines, air conditioning, powerhouse engineering.

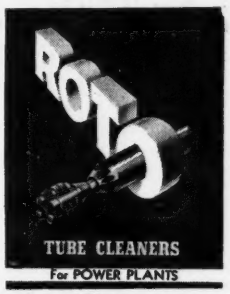
(Continued on page 120)

It Pays to Fight Scale with MODERN ROTO Tube Cleaners

Modern equipment is as vital in your plant as at the front. A machine gun can't be licked with a musket. Nor can you expect to lick rising fuel and labor costs with old fashioned tube cleaners.

The new Roto works like a machine gun. A rapid-action "trigger" air valve on the powerful motor enables one man to clean tubes by himself faster than a man and helper using old style cleaners. New, more durable materials, new design cutter heads, universal joints and hose assure you of greatly increased cleaning effectiveness and lower cost of upkeep.

Let up prove that it will pay you to get the new Roto Tube Cleaner now. Write.



Send for our illustrated bulletin describing various types and sizes of Roto Tube Cleaners for Power Plants.

The ROTO Company 145 Sussex Ave. NEWARK, N. J.

The Voice of Business

Through their advertisements in POWER PLANT ENGINEERING alert business concerns broadcast to engineers and executives latest news on improved equipment for generating and utilizing power. Reading these messages will help keep you posted on the progress of the field and make more competent buying recommendations.

★ SPECIFY-ERNST ★
LEAKLESS COCKS
HAVE YOUR BOILERS EQUIPPED WITH
"SPLIT-GLAND"
ADJUSTABLE WATER GAGES
FOR FLAT OR ROUND GLASSES
AT ALL TEMPERATURES AND PRESSURES VERTICAL or INCLINED
MADE TO FIT ANY WATER COLUMN OR BOILER
Split-gland shown open for replacement of flat-glass unit.
HOW IT WORKS
Split-gland shown closed for compression of packing gasket.
FOR CLEAR VISION USE ERNST PLAIN SIGHT ILLUMINATORS
SEND FOR CATALOG P2
SAFETY and SATISFACTION
FOR COMPLETE WATER COLUMN EQUIPMENT "Better C" ERNST
Water Columns Forged Steel For All Pressures
Wire Glass "Better C" Guards
REFLEX "G-Black" Glass Inserts
High pressure and temperature Gage Glass Gaskets—"They Won't Blow Out."
ROUND - TUBULAR GLASSES for High Pressure Service — Clear or Red Line Magnifying.
CLEAR
REFLEX
COVER GASKET
PRESSURE GASKET
CLEAR & REFLEX GLASSES, all sizes
ERNST WATER COLUMN & GAGE CO., LIVINGSTON, N. J.
DISTRICT OFFICES: NEW YORK · INDIANAPOLIS · CHICAGO · LOUISVILLE · PITTSBURGH
DENVER · TULSA · HOUSTON · DETROIT · CLEVELAND · LOS ANGELES

Reliable Buying Bulletins

In these pages you will find advertisements of firms that make every type of machinery and equipment for generating, distributing and utilizing power. Their messages constantly record latest progress in power plant equipment. They tell you who makes it, who stands behind it. Consider their advertisements as convenient and reliable buying bulletins.

67 Oil Fire Control—In a well-illustrated, 77-pp. book, Report on Mulsifyre Projectors (Underwriters' Laboratories, Inc.) is described an emulsification system for extinguishing oil fires with water alone. Diagrams show installations of transformers, turbines, oil switches, pipe lines, oil coolers and open tanks, with test records and field reports of results. Every man who is responsible for handling oil fires will find it of interest. Grinnell Co., Inc.

68 Tools and Wrenches—Catalog O, a 96-pp. bulletin covers the complete line of Snap-On wrenches and blue-point mechanics' tools including midget, ferrit, master socket, torque and other special wrenches, mechanics' tools, tool boxes, chisels, punches, files, pulling equipment, electric drills, grinder wheels, bolt cutters, reamers, etc. Snap-On Tools Corp.

69 Lubrication—"Diesel Operation—Fuel and Lubricants" is the title of an 80-page catalog of charts, diagrams, photographs and text intended to help the Diesel engineer and executive in lubrication problems they meet. The Texas Co.

70 Maintenance Handbook—A new 74-page "Handbook of Building Maintenance" has just been issued by the Flexrock Co. It contains practical information for factory engineers and maintenance men, shows how to do hundreds of odd jobs with better results and at lower cost. More than 150 pictures, diagrams and drawings.

71 Fire Fighting—"What To Do In Case Of Fire" is told on a new poster which gives brief, concise instructions on how extinguishers should be used on each type of fire. The wall poster also gives basic fire fighting facts on carbon dioxide, foam, carbon tetrachloride and water-type extinguishers. Walter Kidde & Co.

72 Information on Packings—Catalog No. 40 gives complete data on all types of packings for every service. Service charts are included to make the proper packing selection an easy matter. The Belmont Packing & Rubber Co.

73 Electric Vibrators—Folder shows typical installations of electric vibrators for keeping materials flowing freely through hoppers, chutes, increasing weight contents, and eliminating air pockets. Syntron Co.

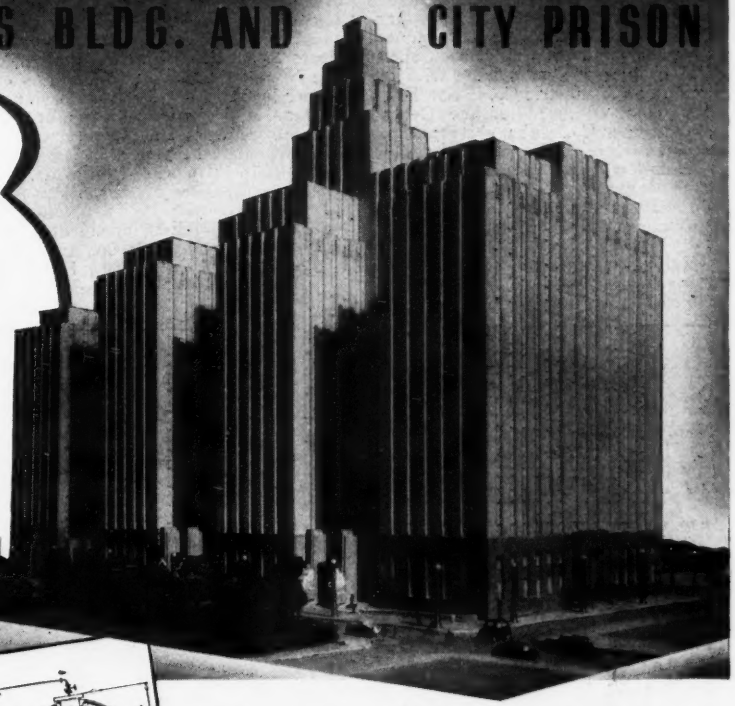
74 Packings—Attractive 48-page Bulletin lists and describes various types of Raybestos-Manhattan packings. Contains tables of weights and dimensions; also handy recommendation charts for many packing and gasket jobs around power and industrial plants. United States Division of Raybestos-Manhattan, Inc.

75 Steam Cleaner—New illustrated bulletin, 8 pages, describes "Hypressure Jenny", a portable steam cleaner which quickly cuts and flushes grease and dirt from engines, motors and other machinery, buildings, etc. Homestead Valve Mfg. Co.

76 Emergency or Routine Repairs—A 40-page guide to the use of Smooth-On cements contains 170 diagrams and tells how pipelines, boilers, cylinders, stripped threads, loose bolts and similar equipment can be quickly and easily repaired, leaks stopped and loose parts firmly anchored. A copy of this handbook should be in your files. Smooth-On Mfg. Co.

New York City's new $19,000,000, 17 story

CRIMINAL COURTS BLDG. AND CITY PRISON

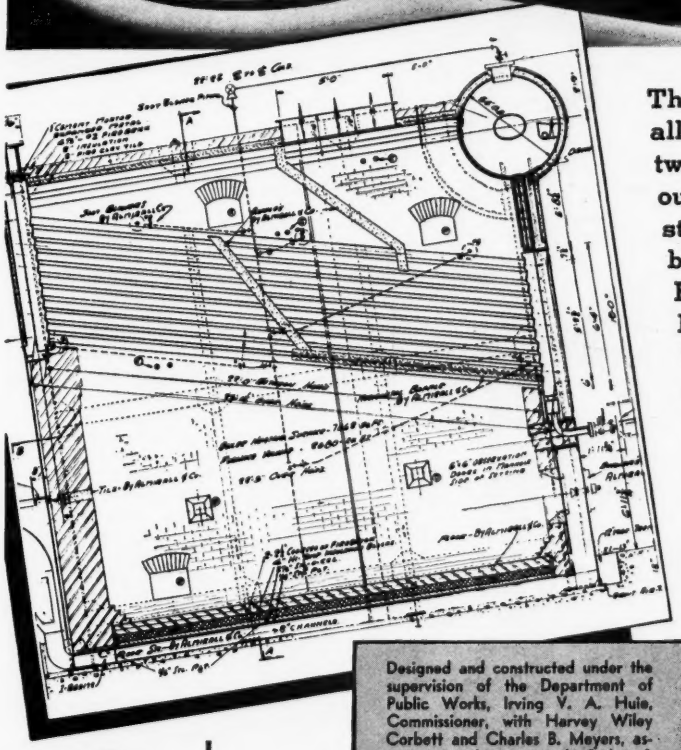


Served by

4 VOGT

Forged Steel

SECTIONAL HEADER BOILERS



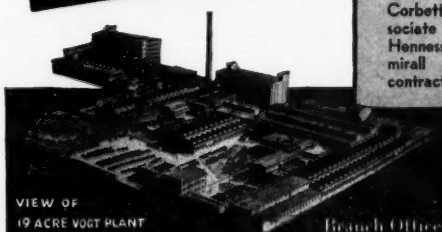
Designed and constructed under the supervision of the Department of Public Works, Irving V. A. Huie, Commissioner, with Harvey Wiley Corbett and Charles B. Meyers, associate architects, and Syska & Hennessy, consulting engineers. Almirall & Company, Inc., heating contractors.

Thirty Court Rooms and Jury Rooms, all completely air conditioned, and a twelve story Prison are housed in this outstanding Public Building. All the steam requirements will be supplied by four Vogt Sectional Header Boilers.

Each steam generating unit has 7,062 sq. ft. of heating surface designed to generate 47,000 pounds of steam per hour at 200% rating, using oil for fuel. Headers, forged from seamless steel tubing, and the fusion welded steam drum are designed for 200 pounds working pressure.

•

Vogt builds steam generating equipment in many types and sizes to meet every heating, power, or processing requirement.



VIEW OF 19 ACRE VOGT PLANT

HENRY VOGT MACHINE CO., Inc.

LOUISVILLE, KY.

Branch Offices: New York - Philadelphia - Cleveland - Chicago - Cincinnati - St. Louis - Dallas

(Continued from Page 114)

Mr. Barker, who has specialized in the development and sale of electrical commodities, was formerly staff manager of the electrical department for Johns-Manville He was an honor graduate of the University of California, College of Mechanics, was associated with the Pacific Gas & Electric Co. in San Francisco, chief engineer for the Central Teresa Sugar Co., Cuba, chief mechanical engineer of the Industrial Accident Commission of California, and joined Johns-Manville in 1921 as Pacific division manager of the power products department at San Francisco.

Ralph M. Hill, electrical manufacturer's representative, Chicago, Ill., announces that Gordon E. Gray has joined his organization to aid in the sale of their electrical industrial lines. Mr. Gray is a graduate of the University of Illinois in Electrical Engineering After graduating, Mr. Gray joined the Electrical Research Department of Sears Roebuck & Co. and later served the North American Car Corp. as engineer in charge of electrical design of mechanically refrigerated freight cars. He entered Sales Engineering work in 1936 when he became associated with the Ohmite Mfg. Co., where Mr. Hill was General Sales Manager.

Thomas Matchett, president of the Robins Conveying Belt Co., announces the appointment of Andrew Hutton as Works Manager of its Passaic, N. J., plant, in charge of all manufacturing operations, buildings and equipment. Mr. Hutton is a member of the Institution of Naval Architects of London, England, a Whitworth exhibitioner with Bronze Medal in Technology and a Senior Member of the Society of Industrial Engineers of America. He was recently Chief Engineer of the Davis Engineering Corp., Elizabeth, N. J., and previously vice-president and general manager of the Taylor Mfg. Corp., Milwaukee, Wis.

THE ANSWER TO YOUR AUTOMATIC CONTROL PROBLEM
FISHER
Type 57T
DIAPHRAGM CONTROL VALVE
STANDARDIZE ON THIS CONTROLLER FOR THESE POWER PLANT APPLICATIONS
General Pressure Reducing Service . . Back Pressure or Relief Valve Service . . Condenser Hot-Well Applications . . Desuperheater Stations . . Soot Blowers . . Hydraulic Couplings . . Boiler Gas Fuel Governors . . Make-Up Regulators . . Turbine Controls . . Steam Jet Injector Service.
● Whether your control requirements are of a special or standard nature, Fisher Governor Company can supply you with a diaphragm control valve that exactly fits your problem. Type 57T can be furnished in an extremely wide range of sizes for all pressures and temperatures. Various designs of throttling inner valves are used to handle different service requirements. Where required inner valves and seat rings may be hardened or stellite faced.
SEND FOR BULLETIN E—IT COMPLETELY DESCRIBES AND ILLUSTRATES FISHER DIAPHRAGM CONTROL VALVES
Exterior view Type 57T with Series 150 flanged cast steel body. Regularly furnished with cooling fin and isolating valve. Stuffing box is self aligning bolted type for high pressure service.
Exterior view Type 57T with screwed globe body. Screwed bodies are available in sizes ½" to 2" inclusive —flanged bodies in sizes 1" to 12" inclusive.
The three throttling type inner valves regularly used on Type 57T control valves. These inner valves provide a variation in flow characteristics to meet the most exacting requirements.
FISHER GOVERNOR COMPANY
• 1002 FISHER BUILDING •
MARSHALLTOWN, IOWA

Bernard E. Winger recently announced his resignation, effective May 10, as master mechanic of the John Morrell & Co. plant in order to become vice president of the Winger Mfg. Co., Ottumwa, Ia. Mr. Winger's association with John Morrell and Co. dates back to 1909. As master mechanic of the Ottumwa plant since 1924 he has been responsible for the maintenance of machinery and all other physical properties of the plant He has been a member of the National Association of Power Engineers since 1914 and served as Iowa state president in 1930.

Kaye and MacDonald, Inc., West Orange, N. J., announces the following new representatives of K-Master steam traps: Gerry H. Wieland, 6740 E. 13th St., Indianapolis, Ind.; Wm K. Clow, Jr., 610 W. Michigan St, Milwaukee, Wis.; Richard Equipment Co., 2137 Reading Road, Cincinnati, Ohio; Ernest E. Lee Co., 343 So Dearborn St., Chicago, Ill.; Norman W. Calvert Co., Auditorium Bldg., Cleveland, Ohio; Dale Prentice, 424 Book Bldg., Detroit, Mich.; Bower Supply Co, 1902 S. Harrison St., Fort Wayne, Ind.; E. A. Rogers, Chattanooga Bank Bldg., Chattanooga, Tenn.

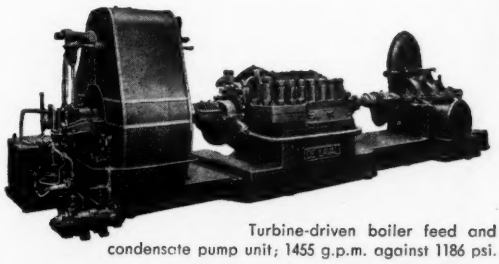
Harlow Bradley, of Milwaukee, Wis., and for many years connected with the Allis-Chalmers Mfg. Co., has recently been appointed Supervisor of Foreign Dealers, according to Max W. Babb, president of the company. In his new capacity, Mr. Bradley's chief duties will be to promote the sale of the company's main line of industrial machinery in foreign countries. His headquarters will be Milwaukee.

Hagan Corp., the Buromin Co., and Calgon, Inc., combustion and chemical engineers, Pittsburgh, Pa, announce the opening of a branch office in Detroit, Mich., at 2512 Book Building. Arthur R. Borden will be in charge of Hagan, Hall Service and Buromin activities with respect to automatic combustion control and boiler-water conditioning applications. Robert Graf will handle the business of Calgon, Inc. They will be assisted by W. H. Weitzel.

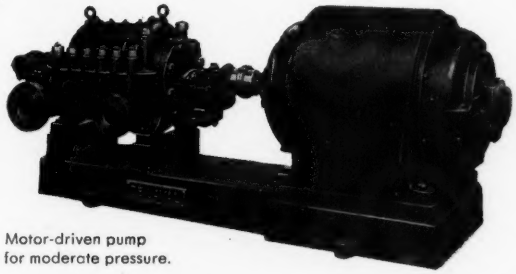
Micro-Westco, Inc., Bettendorf, Ia., has recently announced the appointment of H. L. McNally to position of Sales Manager of the Westco Pump Division. Mr. McNally joined the company over 16 yr. ago and steps into his present position with a wealth of practical knowledge of pump production and sales, gained through his varied experience in the factory, office and field.

Whatever the capacity or pressure of your boilers or the temperature of the water

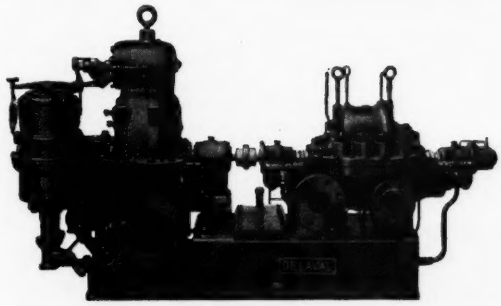
a DE LAVAL boiler feed pump is available



Turbine-driven boiler feed and condensate pump unit; 1455 g.p.m. against 1186 psi.



Motor-driven pump for moderate pressure.



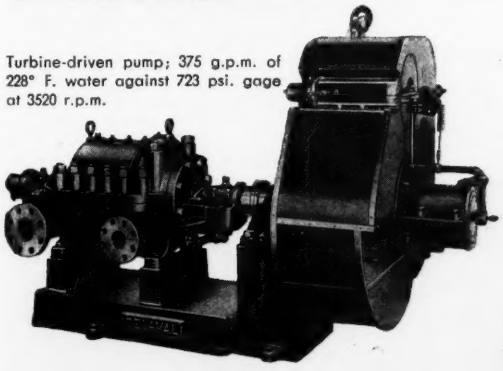
Turbine-driven four-stage pump; 300 g.p.m. of 235° F. water against 575 psi. at 4000 r.p.m.

Distinguishing features which enable De Laval pumps to meet successfully the most severe conditions of present day boiler plants are:

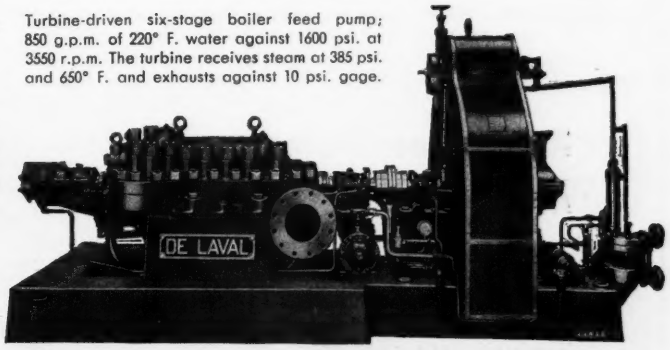
1. **Labyrinth wearing rings,** which permit greatly increased clearances for a given amount of leakage,
2. **Hydraulic axial balancing system,** which maintains rotor accurately in position without dependence upon a thrust bearing,
3. **Improved high quality alloys,** which meet the special requirements of the several parts, and
4. **Limit gage manufacture** upon an interchangeable basis, supplemented by
5. **Complete test** at the designed capacity, pressure and temperature before the pump leaves our shops.

Ask for Catalog P-3623.

Turbine-driven pump; 375 g.p.m. of 228° F. water against 723 psi. gage at 3520 r.p.m.



Turbine-driven six-stage boiler feed pump; 850 g.p.m. of 220° F. water against 1600 psi. at 3550 r.p.m. The turbine receives steam at 385 psi. and 650° F. and exhausts against 10 psi. gage.



HYDRAULIC INSTITUTE U.S.A. MEMBER

DE LAVAL *Steam Turbine Co.*

TRENTON, N. J.

MANUFACTURERS OF TURBINES STEAM, HYDRAULIC, PUMPS CENTRIFUGAL, PROPELLER ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF PRIMING CENTRIFUGAL BLOWERS and COMPRESSORS, GEARS WORM, HELICAL and FLEXIBLE COUPLINGS

Pays for itself the First Year
THE·VILLAGE·OF·WINNETKA
Incorporated in 1869
WINNETKA, ILLINOIS
August 28, 1940
United Paperboard Company,
171 Madison Avenue
New York, N. Y.
Attention of Mr. D.H. Riemer, Mgr. of Purchases
Gentlemen:
Relative to your letter of August 25, we can advise that we are one hundred per cent satisfied with the Hays meters and automatic combustion control equipment installed in our electric power plant.
Its operation has been remarkably trouble free and has performed its duties very efficiently.
It is difficult for us to evaluate the actual savings derived from the installation of this equipment as we installed new boilers with higher pressure and temperature at the same time that we installed the Hays equipment. Our overall saving is approximately 24% over the old boilers and equipment, but how much of this can be allocated to the Hays control is difficult to estimate. However, we are satisfied that the automatic combustion control is an important factor and I feel certain paid for itself within the first year of operation.
Very truly yours,
Supt. Water and Electric Dept.
CRM/HM

The above letter was sent voluntarily in answer to a request for information.

A MUNICIPAL light plant in a mid-western city, through a modernization and expansion program including Hays Automatic Combustion Control, improved its operating efficiency around 24%. Steam pressure was raised from 225 lbs. to 450 lbs., total temperature from 500° F. to 750° F. and fuel consumption per kw.-hr. output was reduced from 2.32 lbs. to 1.73 lbs. Efficient and economical combustion with practically no smoke or fly-ash is maintained by the Hays Automatic Control as well as a constant steam pressure regardless of load fluctuations.

NOTE TO ENGINEERS:
TEAR OFF THE BOTTOM OF THIS AD AND MAIL WITH YOUR NAME AND ADDRESS TO HAYS CORPORATION AND WE WILL SEND YOU A COPY OF "AUTOMATIC COMBUSTION CONTROL AND ITS RELATION TO LOWER STEAM COSTS."

Hays Engineering organizations throughout the country are ready to advise you how automatic combustion control may be able to improve the operating conditions in your own power plant—no obligation. Write us.

The HAYS CORPORATION
SINCE 1901
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

Repetition Helps Make Reputation . .

Year after year alert, far-seeing manufacturers continue to record through the pages of this publication the progress they are making in the power plant field. Through both prosperous and lean seasons these advertisers have helped point the way to more reliable, more profitable plant operation. They know that repetition helps make reputation.

James P. Gillies has recently joined the Chicago Pneumatic Tool Co. of New York to assist in general sales activities. Mr. Gillies has been active in the industrial field for many years.

T. S. Hammond, president of Whiting Corp, Harvey, Ill., announces changes in personnel as follows: S. H. Hammond, formerly manager of Appliance Division, will be in charge of all branch offices as Director of Field Force. Mr. Hammond, R. A. Pascoe, controller, and W. L. Badger, in charge of development and research, are added to the board of directors. M. F. Becker, formerly Field Force Director, becomes vice-president and co-manager of the Equipment Division.

Universal Gear Corp., Indianapolis, Ind., announces the appointment of J. F. Johnson and associates as district representatives for western New York, including the Buffalo and Syracuse areas, in full charge of the company's activities in that locality, with offices at 707 Dun Building, 110 Pearl St., Buffalo, N. Y.

Steel Products Sales Corp, 52 Vanderbilt Ave., New York, has been appointed New York representative of the Downingtown Mfg. Co., Foundry Division, Downingtown, Pa., and also represents the Key Co., Steel Castings Division, East St. Louis, Ill., and Union Boiler and Mfg. Co, Lebanon, Pa.

Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Chrysler Building, New York City, announces the appointment of Newton P. Selover to the position of Western Sales Manager, with headquarters in Chicago, replacing Robert Watson, who recently resigned. For the past 7 yr., Mr. Selover has represented this division on the Pacific Coast, with headquarters in San Francisco.

Lou R. O'Connor, Seattle, Wash., has been appointed representative of Ampco Metal, Inc., of Milwaukee, Wis. His territory will include the states of Washington, Oregon, Idaho, and Western Montana.

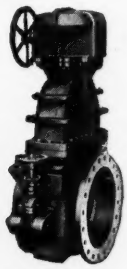
R. E. Spencer Geare, M. E., is now connected with Thermoid Rubber Division of Thermoid Co., Trenton, N. J., according to an announcement made by F. E. Schluter, President.

A. E. Stacey, Jr., Chairman of the American Society of Heating and Ventilating Engineers' Committee on Research, announces the appointment of E. C. Hach, Westfield, N. J., to the staff of the Society Research Laboratory located at the Experiment Station of the U. S. Bureau of Mines in Pittsburgh, Pa. Mr. Hach comes to the Laboratory with an extensive background of experience in which he has served as chief engineer of the manufacturing department of Standard Air Conditioning, Inc. Prior to this connection he was employed by the Carrier Corp., Syracuse, N. Y., where he was engaged in research and development work both in the laboratory and in the field, and he also has held positions with the Beckwith Co. in Dowagiac, Mich, Western Electric Co., Cicero, Ill., and the Mutual Fire Prevention Bureau, Chicago, Ill.

When you need Iron-Body Double-Disc Gate Valves

Some of the Kennedy Iron-Body Double-Disc Gate Valve Types

Low-pressure non-rising stem flanged valve



Electrically operated valve with by-pass and square bottom

175-lb. outside-screw-and-yoke screwed valve

250-lb. non-rising stem flanged valve

Ball-end valve for water mains

800-lb. valve for oil or gas

Small electrically operated valve

Cylinder operated valve

you will find 568 different types and sizes in the new Kennedy Catalog

Whether you require valves for low, standard, or extra heavy pressure, for steam, water, oil, air or gas, and for operation by hand, gear, cylinder or electric motor, you will find an exactly suitable type in the Kennedy catalog—with all data complete and conveniently arranged.

Some of the distinctive features of this new catalog are dimensions, prices and service recommendations on the same or facing pages for all types of valves, large illustrations throughout, sectional views with part lists for all valves, convenient references to accessories and pipe end standards, five different indexes for greatest ease of finding the desired information, and a large section of useful engineering data. Every operating and designing engineer should have a copy of this informative 240-page letter-size cloth-bound volume.

The Kennedy Valve Mfg. Co. . . . . Elmira, N. Y.

Send the coupon for your copy

The Kennedy Valve Mfg. Co., 2001 E. Water St., Elmira, N. Y.
Please send copy of your new 240-page catalog.

Name .....

Position .....

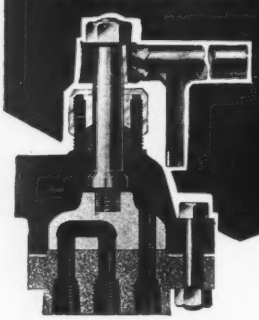
Company .....

Address .....

KENNEDY

Extra Values in VALVES and PIPE FITTINGS

NICHOLSON CONTROL VALVES



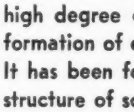
never stick

BECAUSE they hold tight, never stick, and give notably quick control service, Nicholson Valves are ordered and reordered for pressures up to 300 lb. in operating steam, air or water cylinders. They are available in TWO, THREE, FOUR-WAY and special types and made in five different metal combinations to cover all mediums handled. Non-corrosive metals are used on all vital parts. Nicholson also offers foot, solenoid, and motor operated valves; also valves for hydraulic service up to 5000 lb. pressure. Ask for latest Catalog No. 140 on Nicholson Control Valves.

Other Nicholson Products include: Industrial Steam Traps, Welded Floats, Piston and Weight Operated Traps, Flexible Couplings, Steam Eliminators and Separators, Compressed Air Traps.

W. H. NICHOLSON & COMPANY
160 OREGON ST. WILKES-BARRE, PA.

NUGENT FILTERS Will NOT Remove Diesel Oil ADDITIVES



NUGENT Patented **OIL FILTERS** are strongly advocated by leading Diesel engine manufacturers and principal oil companies because of the special ability of these efficient filters not to change the original composition of the oil, nor to remove the special additives put into the original oil during refining processes.

No chemicals or diatomaceous earth are used in the filter mediums of Nugent Filters, because these materials may remove the very ingredients the oil companies have experimented with for years to put in their oils to enhance their lubrication qualities. Now that they have attained this high degree of efficiency, which prevents gumming, sticking rings, and formation of engine varnish, it would be ruinous to use an improper filter. It has been found that the use of improper filters changes the chemical structure of some oils so as to destroy the adherence as well as cohesion of the oil on the bearings; in other words, allowing metal to metal contact. Write for complete information on Nugent Filters for fuel and lubricating oil.

Specify Nugent Fuel and Lube Oil Filters for Your Diesels.

Available in 7 sizes, from 1 to 130 G.P.M.—Send for Bulletin 7A.

WM. W. NUGENT & CO., INC., Established 1897
423 N. Hermitage Ave., Chicago, Illinois.

MANUFACTURERS' NEWS

Owens-Corning Buys Lonsdale Co. Mill

Purchase of the Lonsdale Co. mill in Ashton, Rhode Island, to expand production of Fiberglas has been announced by Harold Boeschenstein, president of Owens-Corning Fiberglas Corp. The company has completed plans to adapt the plant to its needs and install equipment by June 1 to manufacture fibrous glass that subsequently is woven into all-glass tapes and cloths used for a variety of purposes, many of them urgently needed for defense. The Ashton plant is in the Providence industrial area and was selected because of nearness to mills that weave the all-glass tapes and cloths as well as to electrical manufacturers whose needs the Ashton plant is primarily intended to serve. Expansion is required because of urgent demands from the electrical manufacturing industry for Fiberglas to insulate motors, generators, transformers, wires and cables, and from the army and navy for other defense needs.

Turning Gears for Sherman Creek

Motor-driven turning gears will be incorporated for the first time, in three mechanical-drive turbines now being built by the General Electric Co. for the Consolidated Edison Co.'s Sherman Creek station. These turbines, rated 1685 hp. at 4340 r p.m., are to be of the condensing automatic extraction type, for boiler feed pump drive, the third being held as a spare. The turning device will keep the rotor of this spare moving at approximately 10 r.p.m., so that it can be put on the line immediately without requiring any preliminary warm-up. Steam will be 185 p.s.i gage, 485 deg. F., 4 p.s.i. absolute back pressure and arranged for automatic extraction at 75 p.s i. gage.

General Electric stockholders on March 14 totaled 215,556, an increase of 4637 over a year ago, it is announced recently by W. W. Trench, secretary of the company. The number receiving the April dividend was an increase of 2716 over the last record date, Nov. 22, 1940.

Special 3-dav engineering schools will be held by the Iron Fireman organization, in Cleveland May 19-21, in New York May 22-24, in Atlanta May 26-28, in St. Louis June 2-4, in Minneapolis June 5-7.

Survey by W. S. Farish, president of Standard Oil Co. (N. J.) has shown that demand for aviation gasoline in 1939 was 130,000,000 gal., only a minor part of this being 100 octane, used for fighting grade and a few commercial lines. Refineries are now equipped to deliver 550,000,000 gal. per yr. of 100 octane and it is estimated that investment of $30,000,000 will enable them to double this capacity within 14 mo. Lower octane can be produced when demand warrants.

HOW MANY H.P. in Your Unit of Fuel?

The answer depends upon two factors—the B. T. U. rating of the fuel itself—and your ability to convert into useful work a high percentage of those B. T. U's.

Getting maximum steam output from fuel is not a "gift" these days. The secret is contained in treating the complete power plant as a unit. Whether you burn oil, gas, or coal, the starting point in reduction of power costs is the accurate measurement of flows, $\%CO_2$, temperatures, pressures, drafts and liquid levels.

Regardless of the size of the plant, Brown Indicating and Recording Instruments furnish the essential information to operators and engineers which enables them to obtain the maximum steam output.

BROWN FLOW METERS . . . provide records of individual boiler output and steam consumption of various units and departments—the rate and quantity of water fed to each boiler permitting check on blowdown and boiler feed regulation.

BROWN CO_2 METERS . . . when used as a firing guide, enable operators to hold the correct per cent CO_2 and prevent fuel losses due to improper fuel-air ratios.

BROWN PYROMETERS AND THERMOMETERS . . . are essential guides in checking air, gas, water and steam temperatures.

BROWN PRESSURE GAUGES . . . aid in maintaining correct Drum, Header and Line Steam Pressures as well as pressure drop across regulating valves.

The continuous chart records reveal instantly any deviation above or below the most efficient operating conditions. By analyzing chart records of flow, $\%CO_2$, temperature, pressure, liquid level, etc., management can properly allocate costs and increase the standard of operating efficiency.

BROWN Engineers will be glad to recommend the instruments most suitable for your boiler room or plant requirements. Write for catalogs. THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4491 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—Amsterdam-C, Holland: Wijdesteeg 4—Stockholm, Sweden: Nybrokajen 7—England: Wadsworth Road, Perivale, Middlesex.

Definite Ways - to REDUCE POWER COSTS . . .

- MEASURE AND RECORD

AIR . . . Temperatures at preheaters.
" Flow from compressors.
" Pressure from compressors.

- MEASURE AND RECORD

COMBUSTION—Per cent. CO_2 in flue gas. Temperatures of gases leaving boiler.
GAS . . Temperatures at preheaters.
" Temperatures at economizers.
OIL . . . Flow to burners.
" Pressure to burners
" Temperature to burners.

- MEASURE AND RECORD

WATER Fed to each boiler.
" Pressure at boiler inlet.
" Level in boilers.
" Temperature at boiler inlet.
" Temperatures at economizer.
" For make-up.
" Concentration in boiler drum.

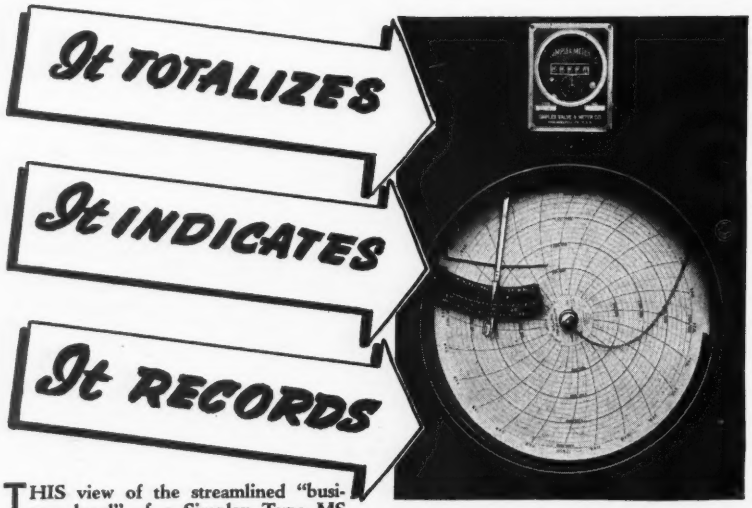
- MEASURE AND RECORD

STEAM Flow from each boiler.
" Flow to auxiliaries.
" Flow to individual units.
" Flow from bleeders.
" Flow to factory departments.
" Flow to heating system.
" Pressure on main header.
" Pressure at feed water heater.
" Pressure at all units.

BROWN INSTRUMENTS

AND MINNEAPOLIS-HONEYWELL CONTROL SYSTEMS

For Temperatures . . . . . Pressures . . . . . Flows . . . . . Liquid Levels



THIS view of the streamlined "business head" of a Simplex Type MS Meter shows how it gives plant engineers an accurate 3-way picture of important water flow conditions:

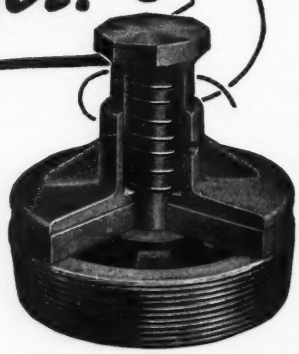
1. By a uniformly graduated Indicating Scale;
2. Direct reading on a graduated Recording Chart;
3. By easily-seen Totalizer Dial at top.

Simplex Meters can be used in any size of main to totalize the flow of Boiler Feed, Condensate, Steam, Air, Gases and Corrosive Liquors. They are extremely accurate over wide ranges, moderate in price, easy to maintain. Write for descriptive Bulletin No. 52.

SIMPLEX VALVE & METER CO., 6790 Upland Ave., Philadelphia, Pa.

SIMPLEX METERS

Amazing Offer!



This Non-Tilt Pump Valve Pays Its Way . . . Or It Won't Cost You A Penny

The improved straight-lifting of the COMBINATION Pump Valve prevents tilting and virtually overcomes costly slippage due to sluggish valve action.

After checking over scores of performance records where COMBINATION Pump Valves have returned their cost in from three to nine months, we are prepared to make this amazing offer:

COMBINATION Pump Valves must prove their ability to pay their way on your particular pump jobs, or else they will not cost you a single penny. They will make good or we will.

Take advantage of this chance to check needless power waste and expensive pump valve maintenance. The coupon brings you full details of this generous COMBINATION Trial Offer. Mail it today.

For Boiler Feed, Vacuum, Condenser, General Service Pumps

COMBINATION PUMP VALVE CO.
846 Wiota Street **Philadelphia, Pa.**

Without obligation, please send me full details about your Trial Offer on Combination Pump Valves.

Name .....

Company .....

Address .....

MAIL COUPON TODAY

News from the Field

Oil Power Engineers to Meet

ARRANGEMENTS have been completed for the National meeting of the Oil and Gas Power Division of the A. S. M. E. at the Hotel President in Kansas City, Mo., June 11 to 14. The program includes sessions on new developments, power plants, inspection and maintenance, research and supercharging. Under the title of bull session a questions and answers period will be conducted by Diesel experts, under the guidance of C. A. C. Rosen of Caterpillar Tractor Co. Questions should be mailed as soon as possible to Glenn Boyer, Burns & McDonnell Eng. Co., Linwood Blvd., Kansas City.

Papers of interest to Diesel operators are: Design of Diesel Engine Foundations, by Kenneth Larkin; Instruments and Automatic Control Apparatus for Diesel Operation, by W. H. Sisson; Centrifuging of Fuel and Lubricating Oil, by C. W. Bryden; Inspection Instrument and Procedures for Diesel Engines, by Ervin R. Spencer; Diesel Engine Casualty Experience, by H. V. Vander Eb; Hydraulic Characteristics of Fuel Injection Nozzles, by O. F. Zahn, Jr.; Release Pressure Measurements for Indicating Diesel Engine Performance, by H. Jennings and T. E. Jackson; Results from Operating Supercharged Engines in Pipeline Pumping Service, by J. B. Harschman and W. G. Heltzel.

Consumers Power to Spend $14,000,000 for Expansion

THE CONSUMERS Power Co., Jackson, Mich., has authorized a fund of $14,000,000 for expansion and improvements in properties during 1940, including power plants, power substations, transmission and distributing lines, as well as other operating structures and facilities. The program includes further expansion in steam-electric generating station at the mouth of the Saginaw River, near Bay City, where an addition is now nearing completion, scheduled to be ready for service in the spring. This will provide for an increase of 35,000-kw. The additional expansion calls for the installation of a new 50,000-kw. steam-turbine generating unit and accessories, boiler units, condensers and auxiliary equipment, to be completed during the summer of 1942, giving the station a rating of 120,000-kw. Other work includes several large power substations at Flint and vicinity, as well as 140,000-v. transmission line construction.

Wisconsin-Michigan Hydro Plants

THE WISCONSIN-Michigan Power Co., Appleton, Wis., has secured a permit from the Board of Supervisors, Iron County, Mich., for construction of a series of three hydroelectric power plants, two to be located in Mastoden Township and the third in Mansfield Township. The largest station is planned at Peavy Falls, in first noted township, where a

Sure we put TANGENTS on WeldELLS!

TANGENTS don't "just grow" on Weldells. We put them there. And we put them there for *two mighty good reasons:* In the first place it's only sound engineering to keep the weld away from the most highly stressed* zone in the fitting. In the second place, tangents make it easier to line up and weld.

Of course it requires a distinct manufacturing operation to provide these accurately formed straight segments on each end of every Weldell. And of course that operation costs us something—but not you.

Sound engineering design—maximum utility, convenience and economy—these are principles that Taylor Forge has applied consistently for more than 40 years. That's why Weldells have tangents—and why they have the *seven other features* listed opposite.

An important point to remember is that the extra-value features of Weldells, and all other Taylor Forge Fittings, represent *extra dividends* for their users. Weldell quality *costs no more.*

Taylor Forge Catalog 401—the most complete information on Welding Fittings and Forged Steel Flanges ever assembled—is yours for the asking. It contains a lot of useful engineering data, too. *Write for it today.*

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Building

*The reference here is to stresses caused by line movements due to expansion, rather than those caused by internal pressure. Mathematical analysis shows that stresses are maximum in the curved section of the fitting and that such stresses far exceed those existing in the straight section even at points quite close to the point of tangency.

Taylor Forge
WeldELLS
Seamless Pipe Fittings for Welding

OTHER EXTRA-VALUE FEATURES

You can't ask for a single thing in welding fittings that Weldells do not have. No other fittings for pipe welding combine these eight features. In addition to tangents, the features are:

1. **Seamless** — greater strength and uniformity.
2. **Precision quarter-marked ends**—simplify layout and help insure accuracy.
3. **Selective reinforcement**—provides uniform strength.
4. **Permanent and complete identification marking†**—saves time and eliminates errors in shop and field.
5. **Wall thickness never less than specification minimum**—assures full strength and long life.
6. **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
7. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

†Since the marking is pressed into the metal before forming, and since the manufacture of the fittings is carried out at a forging temperature, each in effect receives a heat treatment after the operation. The indentations have no sharp corners or edges and the marking has no effect on the strength of the fitting.

WE READ WATER

Every drop of water and every drop of brine has a story to tell us. We know how to read it and answer the many difficulties it is bringing your plant. The story tells a battle against efficiency in your plant . . . corrosion, scaling, living organisms, too much of this chemical, too little of that. We read it, tell the answer, and have the organic chemicals to correct the water and the brine. Known throughout the Nation are these Haering products . . .

Chrom Glucosates
For Corrosion Prevention

Sodium Glucosate
For pH Adjustment

Sulpho Glucosates
For Oxygen Removal

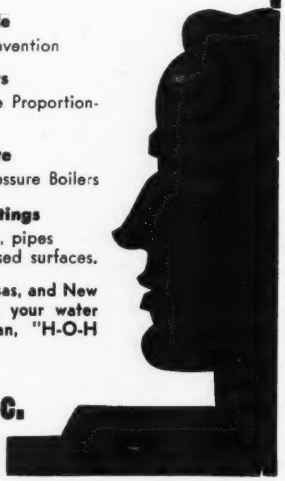
Quachrom Glucosate
For Corrosion Control

Beta Glucoside
For Scale Prevention

H-O-H Feeders
For Accurate Proportioning

Pyro Glucosate
For High Pressure Boilers

In-Hib-Co Coatings
Protect tanks, pipes and all exposed surfaces.



Our laboratories in Chicago, Wichita, Kansas, and New York City serve you overnight. Send us your water problems; or write for our house organ, "H-O-H LIGHTHOUSE."

D. W. HAERING & CO., Inc.
Water and Brine Consultants
2308 S. Winchester Ave., Chicago

If You Have a Problem

or if you need information on the construction, use or maintenance of any kind of power equipment, the editorial staff of POWER PLANT ENGINEERING will be glad to help you find a solution or get the desired information. Please give as complete details as possible as to what you want so that the editors may have a clear understanding of your wishes.

Write Reader Service Department, POWER PLANT ENGINEERING.

multiple arch-type dam will be built with maximum height of 75 ft. above the bed of the stream. This plant will be equipped for a capacity of 22,500-hp. Similarly, in the same township, another station will be built at Michigamme Falls, with power dam of same type noted, and maximum height of 50 ft. above the bed of the stream. This plant will have a rating of 11,400-hp. The third unit, at Hemlock Falls, Mansfield Township, will consist of a conventional type gravity power dam, with maximum height of 30 ft. above bed of stream, with power house to be equipped for a capacity of 6400-hp. Entire project is estimated to cost about $3,250,000.

Florida Power & Light

FLORIDA Power and Light Co., Miami, Fla., has authorized plans for expansion in steam-electric generating station at Miami Beach, including erection of addition on west side of present plant, totaling about 7000 sq. ft. of floor space, to be used for new equipment. Latter will include a new 30,000-kw. hydrogen-cooled turbine-generating unit, Curtis reaction type, with surface condenser designed to use sea water for cooling purposes. Auxiliary equipment will comprise an economizer stack, forced and induced-draft fans, air preheater, traveling water screens, water-treatment apparatus, evaporators, etc. Switch-yard at station will be increased in capacity and additional transformers, oil circuit breakers and accessory equipment installed. Entire project is estimated to cost about $2,500,000. It is proposed to begin work at once and to have new equipment ready for service in 1942. It is planned to landscape the grounds between the station and causeway, constructing an ornamental wall around the property.

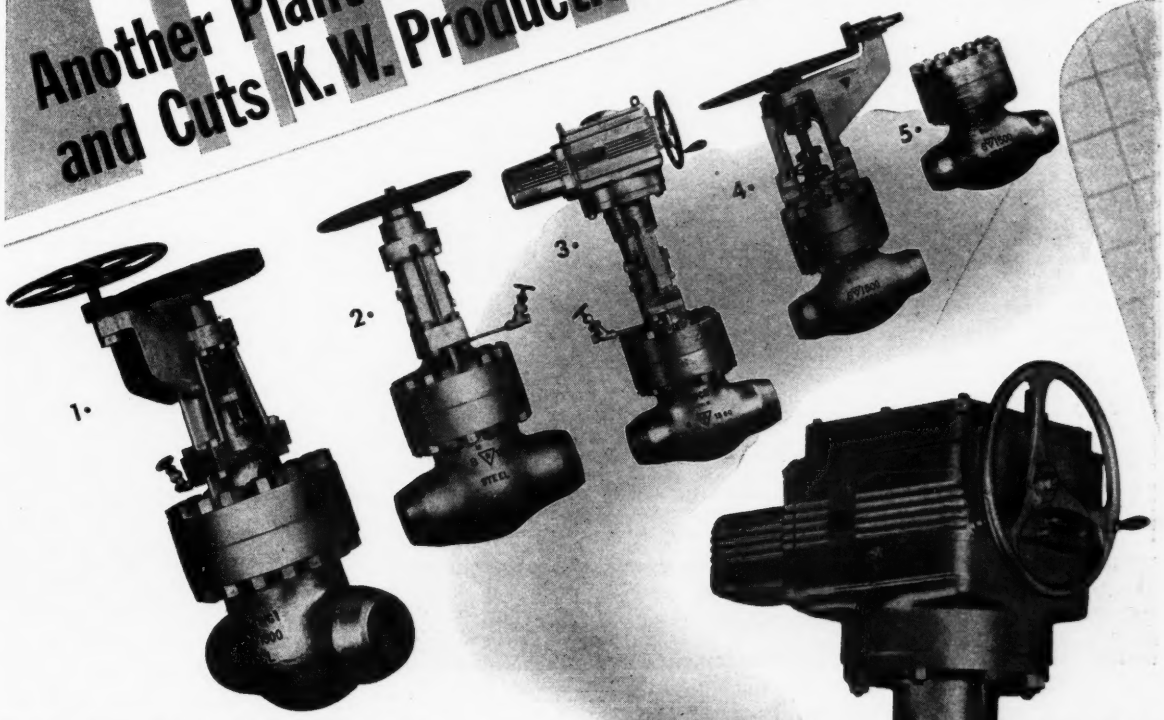
Central Valley Project

THE BUREAU of Reclamation, Denver, Colo., will use an appropriation of about $23,600,000, as now authorized, for the Central Valley Project in California in 1941. With the Shasta dam on the Sacramento River now more than 45 percent completed, work will proceed on power plant and construction of main units, scheduled to be finished during the present year. The Friant Dam on the San Joaquin River similarly is about one-half completed at the present time, and work on the Madera and Contra Costa canals is well in progress. Plans and specifications will be available in near future for initial construction of the Keswick Dam on the Sacramento River, forming part of this project, located about 9½ miles below the Shasta Dam, and call for bids will be made so as to begin construction in 1941. Other accessory work in connection with the hydro-electric power development features of program will be carried out during the present year. R. S. Calland is acting supervising engineer.

Marion Power Station

THE PUBLIC Service Electric and Gas Co., Newark, N. J., has approved plans for further expansion in Marion generating station at Jersey City, N. J., where an extension program has been in progress for a number of months. Present work includes the installation of two high-pressure boilers and a 50,000-kw. turbine-generator unit, scheduled to be ready for service next summer. The addi-

Another Plant *UPs* Capacity and Cuts K.W. Production Costs



Farsighted planning readied this plant for today's stepped-up demand. And it might well be of interest to Engineers and Plant operators that, as part of this program, Reading-Pratt & Cady valves were installed to handle the high temperatures and pressures called for by its Engineers.

Five of these are illustrated above—in addition to the modern, motor operated, 12-inch, 1500 lb. Steel Gate Valve at the right.

1. **12", 1500 lb. Spur Gear operated carbon moly Steel Gate Valve, Stellite trim. For steam service at 1300 lbs. pressure, 930°F.**
2. **8", 1500 lb. Cast Steel Gate Valve, Stainless Steel Stem, Stellite trim with special condensing chamber drain. For main boiler feed service.**
3. **6", 1500 lb. Cast Steel Gate Valve with compensated type motor operator. On boiler feed pump discharge.**
4. **1500 lb. Cast Steel Globe Valve with bevel gear with 1:6 gear ratio for close throttling in auxiliary boiler feed service.**
5. **6", 1500 lb. Lift Check Valve, Stellite trim, Stainless Steel piston and dash pot. On boiler feed pump discharge.**

These installations may suggest that, when Steam Power Plant Valves are up for discussion, you, too, will find it worthwhile to get recommendations from Reading-Pratt & Cady.

12", 1500 lb. Cast Carbon Molybdenum Steel Motor operated Gate Valve, Stellite trim, Stainless Steel Stem, motor control. For main steam manifold service at 1300 pounds—930°F.

READING CAST STEEL VALVES AND FITTINGS
PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

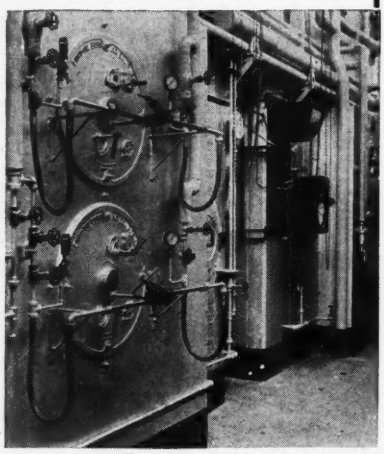
READING-PRATT & CADY
READING, PENNSYLVANIA

A Division of AMERICAN CHAIN & CABLE COMPANY, INC.

Enco Burners

. . . . . *for the efficient combustion of all grades of*

OIL, TAR or GAS



Burner Units of Steam or Mechanical Atomizing Types in various sizes with capacity ranges of from 1 to 1000 gals. per hour.

Designed for operation either with or without air register for natural or forced draft.

The ENCO Interchangeable Oil Burner is designed for instant change of atomizer gun for operation by either steam or mechanical (pressure) system or to cover a wide range of capacity.

ENCO Oil Atomizers are being applied to various types of standard pulverized coal and gas burner units to provide a dual fuel unit for cold starting or for full load operation when coal or gas is not available or when oil is the more economical fuel.

We have made many installations and would be glad to cooperate with those looking for better operation and assurance against loss of steam output.

Write for Bulletin OB-40 and 37 describing ENCO Oil Burning, Pumping and Heating Equipment.

THE ENGINEER COMPANY

75 West St., New York, N. Y.

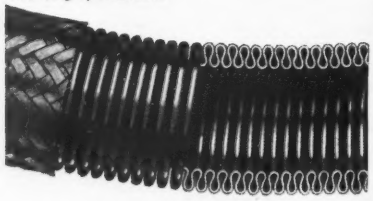
Safe Fuel Lines *with*

PenflexWeld

Jointless Corrugated Tubing

Steel or Bronze to 2"

Courtesy of Fan-Mix



Heat, vibration, expansion and contraction are ever on the alert to cause trouble at the boiler face. Install a length of PenflexWeld and worry no more! Here is the all-metal *flexible* tubing that *cannot leak*, will never burst . . . and lasts a lifetime. Packless couplings are available in a variety of styles convenient for burner tending. If you prefer looped fuel lines, this tubing's remarkable flexibility is a real safeguard. We urge you to give PenflexWeld a thorough try-out.

Send for **Bul. 90**

Pennsylvania Flexible Metallic Tubing Co.

7207 Powers Lane, Philadelphia, Pa.

tion now authorized provides for the installation of another 50,000-kw. turbine unit and auxiliary equipment to duplicate the program now going forward. An appropriation of about $4,000,000 has been arranged for the expansion at this plant, with the entire project scheduled for completion in November, 1942. This will duplicate a similar development program at the Burlington station of the company in South Jersey, where work is under way on construction of a large addition and installation of a new 100,000-kw. cross-compound generating unit. For its 1941 construction and improvement budget, the company has authorized a total of $32,000,000 for all divisions, of which over $21,000,000 will be expended in the electrical department for station expansion noted, power substations, new transmission and distributing lines, and other facilities.

Kansas City Power & Light Co. to Expend $6,500,000

KANSAS CITY Power & Light Co., Kansas City, Mo., is arranging a fund of about $6,500,000 for expansion and improvements in properties during 1941, with part of fund, estimated at $2,500,000, to be used in 1942 for additional generating facilities. The 1941 budget will be used for extensions in power plants and system, including new transmission lines and power substation unit for service for ammunition plants now being located in the Lake City district. Work also will include expansion in distribution system and other operating facilities. The 1942 expenditure noted will be concentrated in an addition to steam-electric power plant on Grand Avenue, with installation to include a new 35,000 kw. steam turbine generating unit and accessories, high-pressure boilers and auxiliary equipment. It is understood that certain awards for primary equipment for this program will be placed during the present year. An additional fund, also, will be arranged in 1942 for other extensions and improvements, maintenance and line extensions.

Kellogg Company to Expend $800,000 for Power Plant

THE KELLOGG Co., Battle Creek, Mich., manufacturer of cereal products, has approved plans for expansion and improvements in power plant at factories for considerable increase in present capacity. Work will include the installation of a new 3000 kw. turbine-generator unit for electric power service both for present and immediate future factory requirements; a new steam-generating unit, with capacity of 100,000 lb. of steam per hour, designed not only for power station use but for requirements in steam kettle food-processing department of plant. Pulverized coal will be used as fuel, and complete equipment for this service will be provided. The new steam-generator will replace a battery of eight old boilers and at the same time develop marked increase in station efficiency. The expansion program will include the installation of a new water treatment plant, removing impurities for boiler feed service in generating live steam for processing plant and turbine unit; also new pumping machinery and complete auxiliary apparatus, as well as equipment for

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

"NEVER TOUCH THEM"

"Our men say they specify your Streamlined 1000 Valves because they are accurate and because they never had to touch one of them since they were installed. I don't see how you could wish for a better report."—Case No. 358.

"Nobody had to look at it"

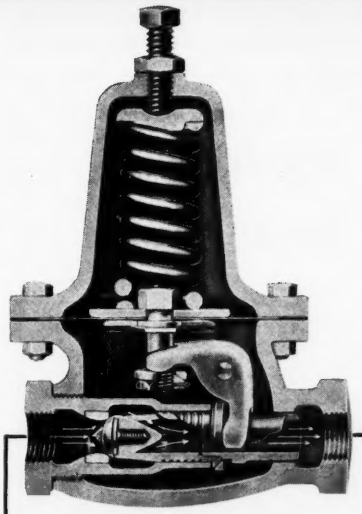
"I was sincere when I told you we had no Streamlined Valve here because I look after all the valves. But since you gave me the date and order number I looked into it and all I can say is—'you're right!' There is one here. But nobody has had to look at it since it was installed two years ago. I'm glad you came back at me because I'm strong for valves like that."—Case No. 360.

"ABSOLUTELY NO TROUBLE"

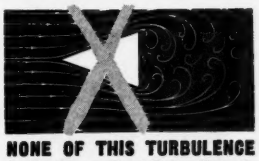
"How long will it regulate without attention? that's our test for any automatic valve. We put our first Streamlined Valve on a job that we thought no regulator could handle 100%. It was a spot where no regulator had lasted six months. Your Streamlined Valve has been handling this job for over three years with absolutely no trouble. Since that time we have bought 20 or 30 more, as you know, and they all give us the same fine performance."—Case No. 337.

"NOT A SINGLE CASE OF TROUBLE"

"We've got a lot of your Streamlined Valves here and they must be working well because I haven't had a single case of trouble reported on them. When something works well we usually stick to it, so you'll be hearing from us right along."—Case No. 366.



Straight Line Flow
FROM INLET TO OUTLET



NONE OF THIS TURBULENCE
In the Streamlined Valve there is no turbulence like that indicated in the diagram above to hinder flow or handicap close pressure regulation.

Trouble-free service seems to be the general verdict — you can expect the very same results when you install a CASH STANDARD Streamlined "1000" valve — but the type "1000" doesn't stop there — plus this you get smooth operation — no flow variation — high capacity — tight closure when not in use—accurate regulation—and, in addition, your type "1000" will contribute towards speedier production and do it at lowest cost to you. Whenever the time should come that replacement is needed, you'll find it only necessary to order an inexpensive replacement part and you can easily install the part yourself.

GIVES THIS FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown above which makes for maximum capacity when it is needed most, and permits accurate pressure control under toughest working conditions.

Try One Free
FOR 30 DAYS

Prove to your own satisfaction just how good type "1000" is—take 30 days to do it—after 30 days a bill is sent to you—you either pay the bill or return the valve to us at our expense. Send for one now.

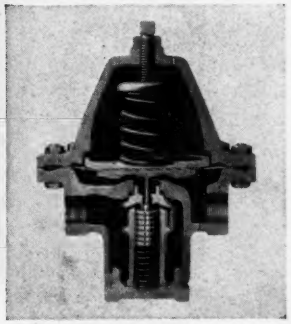
A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

A CASH STANDARD "GET ACQUAINTED" COLUMN

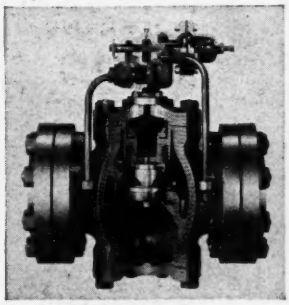
Question: **"Don't you people make anything besides that Streamlined Valve you talk about so much?"**

Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



Cash Standard Class D Pressure Reducing Valve; inexpensive; dependable. Used in regulating steam, hot water, cold water, air, oils, many chemicals and most gases. Sizes ¼" to 2"; screwed ends.

Initial pressures up to 250 lbs., reduced pressures up to 200 lbs. Bodies in iron, bronze or steel. Trim; iron, bronze, stainless steel, monel metal, or nitralloy.



Cash Standard Type 10 Pressure Regulating Valve—self-contained, pilot operated. For holding reduced pressure within extremely close limits.

Sizes: 2" to 12". Initial pressures up to 600 lbs.; highest reduced pressure 250 lbs. For water, air, Freon, ammonia, any non-corrosive gas or oil. Valve operating fluid not wasted: it discharges to outlet pipe.

Bodies: iron, bronze, steel. Trims: iron, bronze, stainless steel, or monel metal. Ends: screwed, flanged, or ammonia type.

Get Free Bulletins on Above . . . Write to
A. W. CASH COMPANY
DECATUR, ILL.

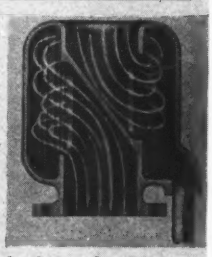
In more than
12,000 Plants
COCHRANE
MULTIPORT
RELIEF VALVE

Cochrane Multiport Back Pressure Relief Valve with front and back plates removed.

Successful operation of the Cochrane Multiport Valve in more than 12,000 plants is a sure guarantee of its continuously reliable operation. This continuous operation is insured by the multiport principle — a number of small discs instead of one large disc, eliminating the sticking, jamming and freezing common to single-disc valves in the control of atmospheric relief, back pressure, etc.

Call your Cochrane representative or write for further details.

COCHRANE Exhaust Head



Designed to separate condensate and oil from steam discharged to atmosphere and thereby prevent raining of water and oily condensate on the roof, Cochrane Exhaust Heads incorporate a highly efficient free-flowing baffle type construction and an exceptionally large port area which minimizes back pressure. Write for further details.

COCHRANE CORPORATION
3123 N. 17th Street, Philadelphia, Pa.

COCHRANE

Cochrane Corp., 3123 N. 17th St., Phila., Pa.
Please send me complete information on Cochrane Multiport Relief Valve and Cochrane Exhaust Head.
Name_____
Firm_____
Address_____
City_____ State_____

replacement of certain present station units. Improvements will be made in steam lines and power distribution facilities. Entire project will require close to nine months for completion and is estimated to cost approximately $800,000. Sargent & Lundy, 140 S. Dearborn St., Chicago, Ill., are consulting engineers. The Kellogg Company also will expend approximately $200,000 for extensions and betterments in manufacturing plant, making a total expenditure of $1,000,000 during the present year. Work will comprise the installation of new cook room equipment, processing machinery, new grit bins and other equipment.

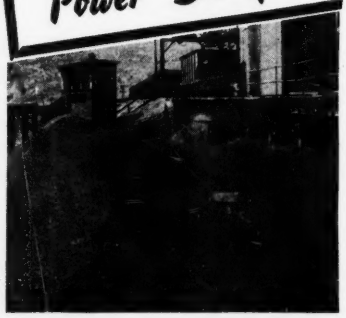
Carolina Power & Light to Build New Plant

THE CAROLINA Power & Light Co., Raleigh, N. C., has plans in progress for new steam-electric generating plant to be located on site in or near the city to provide increased service for local lines. New plant will be equipped with a steam turbine-generator unit of about 40,000 hp. rating, high pressure boilers and auxiliary equipment. Contracts for main equipment will be placed at early date, including boilers, condensers, etc. It is understood that the selection of generator unit has been decided. Entire project is estimated to cost about $3,000,000 including extensions in transmission lines for connection with present system, switchyard and accessory structures. This will be a feature of the 1941 expansion and improvement program of company, now being determined. It is expected to extend rural electric lines during the year, as well as distributing lines in city, with additional power substation facilities.

New Steam-Electric Station to Cost $4,215,000

THE LOS ANGELES Bureau of Power and Light, 207 South Broadway, Los Angeles, Calif., will begin work soon on new steam-electric generating station in the harbor district at Wilmington, where site has been selected and with soil and piling tests now under way. Work will include a multi-story reinforced-concrete station building, with two large tunnels and other substructure work. Installation will comprise a 65,000 kw. steam turbine-generator unit, high-pressure boilers and complete auxiliaries. A contract for the generator has been awarded to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and will be built at the South Philadelphia works of the company. It is said that this will be the largest condensing turbine in the world, operating at 3600 r.p.m. It will be used for reserve and emergency service in conjunction with power supply for the municipal system now being received from the Boulder Dam hydroelectric power development of the Government. It will operate normally at a power load of 5000 kw., with facility for increasing this on short notice to full load capacity of 65,000 kw., whenever necessary. Contracts for other station equipment are expected to be awarded at early date. Work on project will proceed during present year, with completion of plant scheduled in 1942. The plant is estimated to cost about $4,215,000, of which $2,065,000 will be used for station building and auxiliary structures, and $2,150,000 for equipment purchases.

SAUERMAN
Power Scrapers



● For dependable, economical coal storage, a Sauerman Power Drag Scraper with its definite operating advantages, versatility and flexibility, is your best investment. Low initial cost, simplicity of installation and operation, coupled with better handling (coal is stored in layers—eliminating air pockets and hot spots) make the Sauerman system of coal handling the logical method for those who want the best.

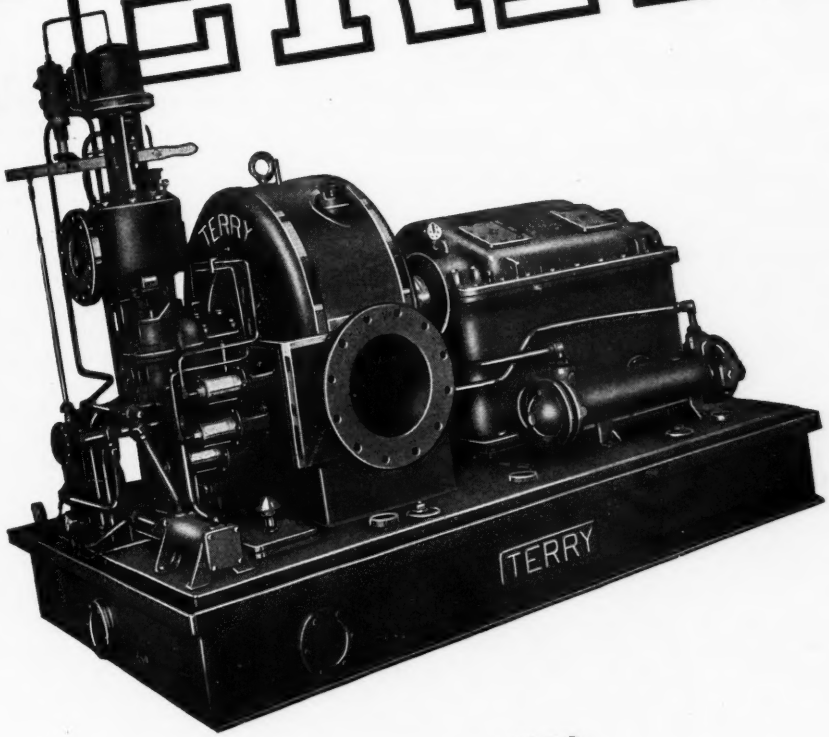
Write for Catalog, data sheets.

SAUERMAN BROS., INC.
486 Clinton Street Chicago, Illinois

How Advertising Speeds Progress

Besides raising our standards of living, good advertising greatly shortens the time between invention and utilization, which speeds the progress of new industries, helps make men and machinery more productive.

TERRY



TERRY TURBINE GEAR UNITS OFFER MANY ADVANTAGES

— They are generously proportioned. The turbine is made entirely separate from the gear and is connected to it through a flexible coupling.

— All parts are ruggedly constructed. They are built to give dependable long-lived service.

— The turbine can be equipped to operate in conjunction with boiler control systems so that they make excellent units for driving forced and induced draft fans.

— Automatic nozzle control, variable speed governors and special control features are available.

— They are backed by over forty years of turbine building experience. Terry engineers will be pleased to discuss with you the proper application of Terry Turbine gear units. Descriptive bulletins gladly sent.

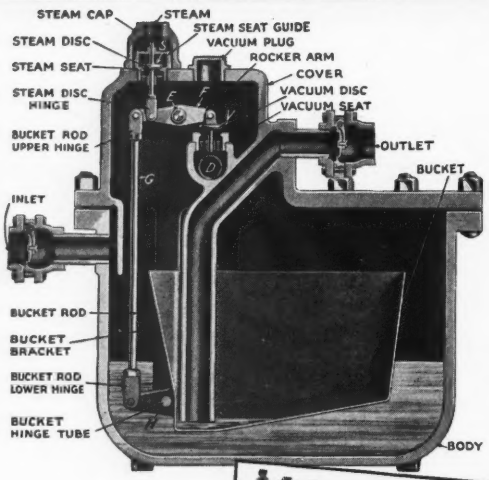
T-1142

Above: Typical Terry Turbine gear unit. Rated 700 HP. One of thirty Terry units used by leading southern power plant.

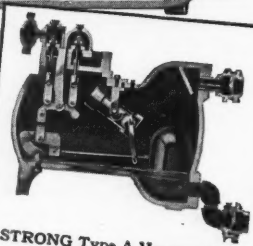
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

PIPEWRENCH PETE SAYS:

Multi-valve trap solves HI-VACUUM DRAINAGE PROBLEMS!



ABOVE: Strong Type M Trap removes liquids from a vacuum or low pressure and discharges to point higher than trap or against back pressure. Uses steam, air or gas only in equal volume to liquid removed.



STRONG Type A Vacuum Trap, primarily for atmospheric-gravity discharging. No steam required.

PLENTY OF SPECIAL FEATURES IN THESE POSITIVE-ACTING, TROUBLE-FREE TRAPS

It's no cinch to lick drainage problems like those you find in condensing engine exhaust lines, vacuum heaters, sump holes and the like. But STRONG has the right answer to all of 'em in these two traps for vacuum, lifting and pumping service—and built to handle water, oil or gasoline.

You'll find lots of smart engineering in 'em to help you do a better job and save the plant important money!

For complete details on this equipment, plus tips on making vacuum or lifting systems work better, get Catalog 64-PPE6 on STRONG Vacuum and Lifting Traps. No obligation, so drop a card now to . . .

The Strong, Carlisle & Hammond Co.
1392 West Third St., Cleveland, O.

STRONG
STEAM SPECIALTIES

INDUSTRIAL POWER EQUIPMENT

SEVERAL important changes in the use of power equipment and electric energy consumption in the manufacturing establishments of the nation are recorded in the recently released Sixteenth Decennial Census of the United States.

Industries of the United States engaged in manufacturing, including the printing and publishing industries, reported a prime-mover installation at the close of 1939 aggregating 21,266,557 hp., a gain of 1,111,160 hp., or 5.5 percent during the decade. They also reported 29,887,966 hp. of electric motors driven by purchased energy, a gain of 31.2 percent over the 22,775,664 hp. reported for such motors 10 yr. before. Despite the aggregate gain in prime-mover horsepower, however, the number of establishments using power equipment totaled only 181,000 in 1939 as against 193,969 a decade ago, a decrease of 12,969, or 6.7 percent.

The greatest gain in prime-mover installation was reported for steam turbines, which increased 3,564,826 hp., or 46.1 percent while the steam-engine installations decreased by 3,066,675 hp., or 31.9 percent. Internal combustion engines of all types increased by 568,958 hp., or 46.1 percent, and hydraulic turbines and water wheels recorded the slight increase of 44,051 hp., or 2.9 percent.

A total of 1,996,753 hp. of prime movers was reported as ordinarily idle, leaving a balance of 19,269,804 hp. in prime movers actively turning the wheels of American industry. Of the total prime mover installation of all types, 13,943,800 hp., or 65.6 percent, was used to drive electric generators, and 7,322,757 hp., or 34.4 percent, performed other power functions.

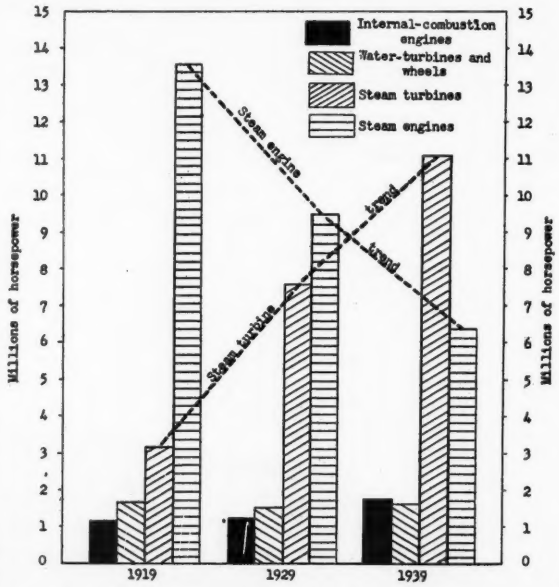


Fig. 1. During the last 20 yr. the gain in industrial steam turbine capacity has been largely at the expense of the steam engine

PROTECT

HIGH TEMPERATURE★HIGH PRESSURE LINES WHEN THEY EXPAND BY INSTALLING...

BADGER *Stainless Steel* EXPANSION JOINTS

THE "PACKLESS" JOINTS

Our Expansion Joint engineers have certainly kept pace with developments in the use of piping in power and process plants. As soon as stainless steel became perfected and generally applicable we experimented with this metal and developed a stainless steel expansion joint built to the well-known Badger Directed Flexing design. It has been on the market for some years now and is thoroughly proved as to its capacity not only to absorb line movements but to resist high temperatures and pressures.

Put these Stainless Steel Expansion Joints on your high temperature or high pressure lines. They're "packless" and throughout their long life you won't have to even look at them. They have the Directed Flexing feature which assures years of service because flexing stresses are kept distributed. They are fabricated under skillfully-applied and controlled heat-treatment which also helps assure long life.

In writing for Bulletin 100, which gives full details, tell us about your problem.

E. B. BADGER & SONS CO.

75 Pitts St., Boston, Mass. **Agents in Principal Cities**

Install Darts

If it is costing you too much to keep your pipes together, it's a sure thing you're not using Dart Unions—or *enough* of them. For Darts *save* you time, work, worry and money. They make up TIGHT—quickly—*stay* tight—and can be re-installed *repeatedly* without losing their original grip. All this is possible because Darts have matched bronze seats, ground to accurate "true-ball" surfaces . . and nut and bodies of air refined malleable iron that resists pipe strains, wrench abuse, corrosion. So—next time you change your piping—change to Dart.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Sales Agents: The Fairbanks Company, New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

Continued trend toward electrification of industry is indicated by the increase of 10,814,584 hp. of installed electric motors, a gain of 30.8 percent for the decade. It is interesting to note that the rate of increase in the use of the two classes of electric motors (those driven by purchased energy and those driven by energy generated within the plant) are nearly the same—31.2 percent and 29.9 percent, respectively. The proportion of the total motor horsepower run by electric energy generated within the manufacturing establishments in 1939 was approximately the same as in 1929—35.0 and 35.2 percent, respectively.

Rating of electric generators in the establishments totaled 9,674,934 as against 7,793,875 kw. in 1929, a gain of 1,881,059. This report, for the first time, shows the types of prime movers driving these generators. The returns indicate that 70 percent as measured in kilowatt rating, were driven by steam turbines. Approximately 10 percent of the total generator rating is reported as ordinarily idle.

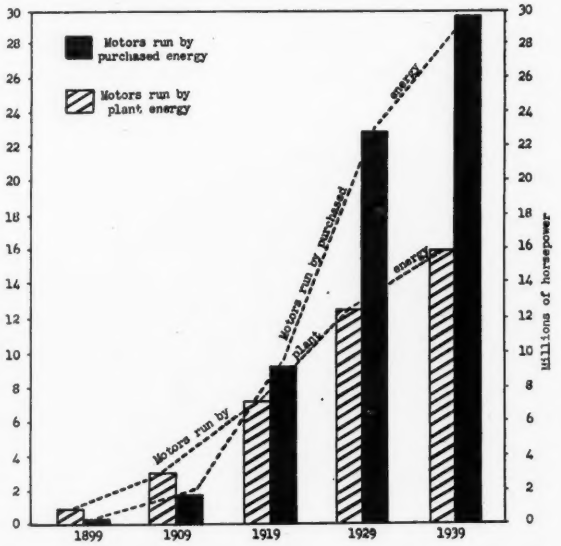


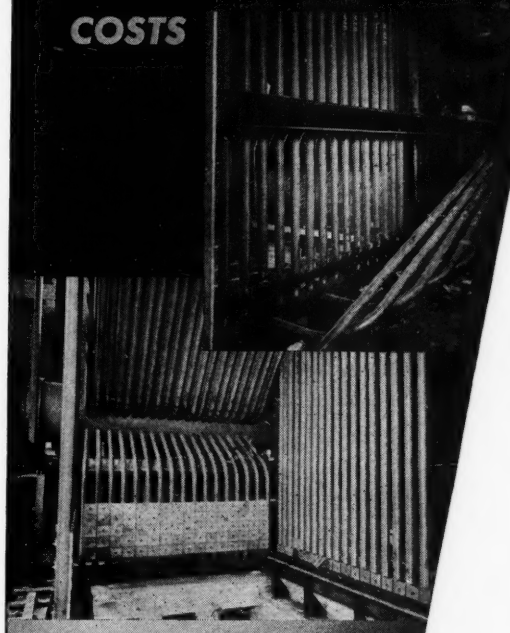
Fig. 2. Trend of motors ran by purchased power and by power made in the plant, in American manufacturing industries

Manufacturing plants purchased a total of 45,040,866,703 kw-hr. of electric energy during 1939, as against 37,393,833,046 kw-hr. purchased in 1929, or a gain of 21.2 percent. The 1939 Census data indicate that 28,749,939,758 kw-hr. were generated in private generating plants of manufacturers of which 2,922,939,919 kw-hr. were sold to other manufacturing establishments, to the general public, or in a few cases, sold to affiliated establishments in other industries. No corresponding data are available for earlier years.

Illinois Department of Labor has announced that payment by employers to men called for training under Selective Service will not be considered as wages, hence need not be reported or taxed under the unemployment compensation act. Wages are defined as "Renumeration for personal services," and since a man in encampment cannot render personal services to his employer, any payment by the employer is considered as a gratuity.

5 IMPORTANT REASONS

WHY GLOBE SEAMLESS STEEL TUBES PROVIDE BETTER PERFORMANCE . . . LOWER OPERATING COSTS



1. No seams or welds. Globe Seamless Steel Tubes are free of weak points, as along the line of a weld, which might give a starting place for costly failure.

2. Structurally uniform and sound from end to end; each tube pierced from a solid billet of steel, resulting in complete homogeneity of wall structure.

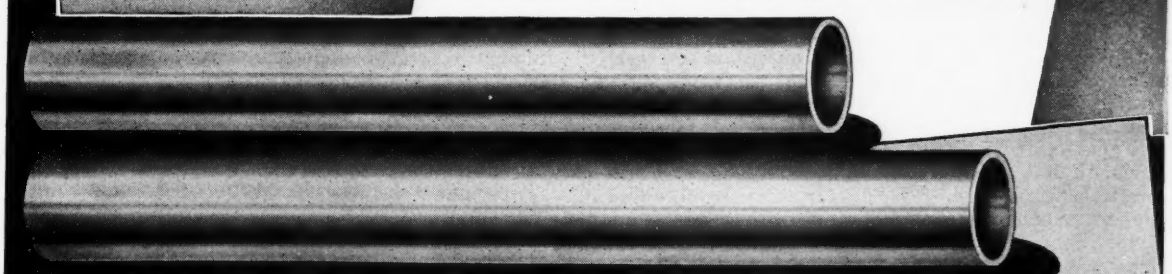
3. Only first-quality killed open hearth and electric furnace steels can survive the Globe piercing operation — a positive guarantee of the soundness of the steels used in producing Globe Tubes.

4. The smooth, solid, unbroken surfaces of Globe Tubes afford the utmost resistance to destructive corrosion.

5. Long service records in many of the nation's noteworthy power plants — their use by leading railroads, industrial and marine boiler builders — attest the greater value, safety, and savings of Globe Seamless Steel Tubes.

Globe engineers are always available to assist in selecting a tube with the exact characteristics for your specific needs. Check with a Globe engineer before you specify boiler tubing.

GLOBE STEEL TUBES CO • 4012 W. Burnham Street, Milwaukee, Wis.



STAINLESS TUBES
BOILER TUBES
CONDENSER AND HEAT EXCHANGER TUBES
MECHANICAL TUBING

GLOBE STEEL TUBES

Seamless for Safety

RELIANCE

Forged Gage Valves

ON your toes to keep everything running without lost time, such annoying details as gage valve troubles can be avoided by installing Reliance Forged Steel Gage Valves. You *know,* then, that you have permanent equipment which won't tax you periodically with repair and replacement expense • Tough SAE 1025 steel is used in the sturdy forged steel bodies, flanges, packing nuts and glands. The stainless stems have multiple threads for quick closing in a quarter turn. Valve is regrinding type, seats removable, reversible — of long-wearing stainless steel. Moulded packing rings for stems and glass-ends withstand high temperature service in steam, oil and chemicals. Extra deep stuffing boxes assure leak-proof assembly • Enjoy the same trouble-free gage valve efficiency that thousands of these valves are giving in stationary and marine service. Write today for Bulletin 401. THE RELIANCE GAUGE COLUMN CO., *5902 Carnegie Avenue, Cleveland, Ohio*

Reliance

Boiler Safety Devices since 1884

METERING SAVES HOTEL MONEY

(Continued from Page 102)

8. Exhaust steam for house heating, water heating, etc.

9. Electric power generated.

10. Electric power used for pumping water, compressing ammonia and other refrigerants, operating ventilating and air conditioning fans, each to be measured individually in the larger hotels.

11. Total flows of these quantities of water, refrigerant, etc., where practical to measure them.

Services chargeable to guest rooms should be measured and grouped under that department. These would include: 1, electric power for elevators; 2, electric light; 3, electric power for ventilating, cooling or air conditioning these rooms; 4, hot water, cold water and ice water; 5, steam for heating.

Public Rooms

These should have charges separate from the guest rooms and the measureable services include: 1, electric light; 2, electric power for ventilating and air conditioning; the refrigerants to be measured, if feasible; 3, steam for heating.

The food business of practically every hotel is operated as a separate department and, therefore, accurate measurements should be made of: 1, electric light; 2, water; 3, steam for cooking and sterilizing and for heating water; 4, refrigeration for food and air conditioning.

The laundry is an important department of most hotels using substantial quantities of heat and power which should be separately measured and charged against that specific operation such as: 1, electric light and power; 2, water; 3, steam for mangles and water heating.

Concessions, Stores and Tenants

These should always be charged for electric and steam service on a metered basis to prevent excessive use of those services. Prolonged arguments with tenants are eliminated entirely by the metered "pay for what you use" basis. Heat, water and cooling services can be metered if used in substantial amounts.

This summary of services to be metered is not offered with the expectation it will exactly fit your hotel. It is hoped that it will call attention to the many places in the average hotel where many dollars flow along every day unnoticed and unmolested on their way to the sewer, the smoke stack, the open window, the inefficient machine, the needless illumination and the many places waiting to embrace the wasted hotel dollar. Meters will spotlight those escaping dollars and they can be captured and corralled in the profit column.

Meters are available at moderate cost to measure each one of those, fuel, steam, water, electric and refrigeration quantities. Selection of the proper meter can readily be made by the hotel's chief engineer.

These meters will cost money. So does everything you provide for the use and convenience of your guests. The hotel itself was a major investment. You buy these new lighting fixtures because they will pay dividends in guest satisfaction and repeat business. That $100 saved by meters hidden away down in the engine room is still just as many dollars as if handed in at the cashier's window by a lot of satisfied guests. The return on the meter investment goes directly into the hotel's profits. These profits will pay off the cost of the meters in a short time and then be clear gain.

NAME Your JOB...

LO-SET RAM-FEED: This CANTON unit is helping to cut heating costs in Schools and Commercial Buildings; also is widely used with medium-sized boilers found in Laundries, Dairies, Packing Plants, Hospitals, Hotels, etc.

CANTON VULCAN RAM-FEED: Stokers are for the tough loads. They are built strong, heavily powered, give good results even with low grade fuels. Special alloy construction and a 5-year guarantee indicate the plus value of this unit.

THERE'S A TYPE OF CANTON STOKER TO FIT EVERY FUEL-BURNING REQUIREMENT

CANTON'S experience with fuel-burning equipment covers a thirty year period during which we have designed and installed virtually all types of stokers including Hand Stokers, Overfeed Stokers, Worm Underfeed and Ram Underfeed units.

In surveying any steam plant, therefore, it is not necessary for us to be partial to any product design. The full coverage of the CANTON line enables us to render a stoker engineering service that helps assure each client the particular stoker design best suited to his plant layout.

That is why we continue to suggest to plant owners and engineers everywhere—"Name Your Job, There's A Type of CANTON STOKER to Fit Your Fuel-Burning Requirements." Write today for latest descriptive bulletins. They point the way to lower steam costs.

CANTON STOKER

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The advice and suggestions in this useful repair manual are based on enthusiastic reports which engineers all over the country have been sending us for 45 years describing hundreds of ways in which Smooth-On has helped them to save time, labor, and money on repair jobs all over the plant.

Some of the subjects covered:

How to seal cracks in casings or shells of pumps, heaters, condensers, evaporators, tanks, engines, valves, etc.

How to stop leaks at seams, bolts, rivets, threaded or flanged joints, etc.

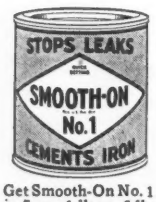
How to tighten loose parts of apparatus, fixtures, etc.

How to waterproof concrete, brick or stone floors, walls, cisterns, etc.

How to improve the appearance of rough or blemished machinery bases and other castings.

How to make up leak-proof pipe joints.

Smooth-On is easy to use, requires no heat, special tools, dismantling of equipment or previous experience, and assures lasting repairs. Smooth-On applications cost but a few cents and save lengthy repair jobs and frequently expensive replacements of apparatus. Buy a can of Smooth-On No. 1 without delay so you will be prepared for emergency repairs and routine maintenance jobs.



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Smash the Atom

GENERAL ELECTRIC has announced receipt of an order for the electric equipment to operate the University of California's new 100,000,000-volt cyclotron, which engineers say will be so powerful that its atom-smashing ion beam will melt an ordinary brick as quickly as a blow torch would melt a pound of butter.

Prof. E. O. Lawrence, Nobel prize winner and among the first to perfect an atom smasher, says this machine will be 16 times greater than his present outfit and will require about three years to build. It will be housed in a specially constructed building the size of a 2-story house on the flats back of the University at Berkeley, California.

Formal description of the electric machinery is "2500 kv-a. power rectifying equipment for oscillator of cyclotron." General Electric engineers explain that this equipment will take 2500 kv-a. supplied at 12,000 volts, 3-phase, 60-cycle, alternating current, at constant voltage and will rectify it to 25,000 volts, direct constant current, which will be fed into the oscillator of the cyclotron, operating at 10,000,000 cycles.

This new giant cyclotron will generate energies of atomic rays greater than any now in existence except in distant stars or somewhere in cosmic space.

Dr. Lawrence, who designed and developed the cyclotron, explained that the new machine will weigh 4900 tons and contain a magnet 56 ft. long, 30 ft. high, and 15 ft. 4 in. wide. The working part is a circular chamber, into which atomic particles are fed. Here they receive successive kicks which cause them to whirl around the chamber in continually widening circles until finally they reach a window or port on the side of the chamber. Any element the scientists wish to bombard will be placed over this window where it will receive the full force of the atom-smashing beam of atomic particles.

Construction of the supercyclotron was made possible through a $1,150,000 grant by the Rockefeller Foundation, to be swelled by an additional $250,000 from other sources.

Training Mechanics

INCREASINGLY acute shortage of skilled mechanics was forecast by Frederick E. Searle, head of the Ford Industrial Schools, in an address before Detroit Chapter of American Society of Tool Engineers. He said that the larger industrial companies have established training courses to take care of their own need. Also various chapters of the A.S.T.E. are organizing educational committees to co-operate with manufacturing plants and trade schools to assist in training apprentice mechanics particularly in connection with defense work. Smaller industries are badly handicapped and will likely be more so, hence such co-operative training is suggested as a promising solution of the problem.

RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

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PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

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CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewall seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE — Premium and standard qualities in the entire range of Anthracite burning characteristics.

Capable engineering personnel and the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

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Don't Let Valve Failure Delay Defense Work

With National Defense requirements calling for the utmost speed, this is no time to risk shut-downs and delays due to valve troubles. Whether your plant is working directly or indirectly on defense work, production MUST continue "full speed ahead."

Interruptions from valve failure can positively be eliminated by using Fairbanks *Renewable* Valves. For if a leak develops after long usage, you simply remove the worn seat ring or disc and slip in a new one while the valve is in the line. This takes only a *few minutes* and costs but a few cents.

Fairbanks Valves represent the highest in material and workmanship, in types to properly fill particular needs.

Why not check up on your valve requirements today and get in touch with your Fairbanks' distributor. Write us for Catalog No. 21.

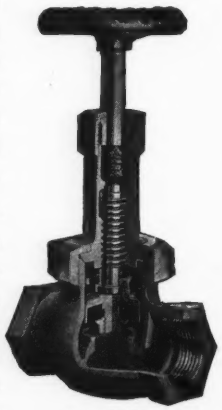

Fig. U-01
150 lbs. steam pressure

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Defense Training

THROUGH the U. S. Office of Education, courses are being offered to give special training to prepare workers in speeding up the national defense program. These are intensive day or evening courses arranged in connection with existing colleges and schools either as individual institutions, or by groups to avoid duplication.

As an example, courses are being offered by Harvard University, Massachusetts Institute of Technology, Northeastern University and Tufts College in subjects for which there is sufficient demand to satisfy requirements of the U. S. Commissioner of Education. Such courses will be given without charge to the students for tuition, and will not conflict with or replace regular day or evening courses now in existence.

All courses are of collegiate grade, requiring 2 yr. of evening engineering school plus practical experience, or three years in an accredited engineering school, or other equivalent in training.

Daytime and Evening Courses

Full daytime courses will be equivalent to a full college term of 16 weeks and will cover airplane power plants, airplane structures, camp sanitation and water supply, building construction, defense production and co-ordination, naval architecture, marine engineering, meteorology, mapping, topography and surveying, and aerial mapping. For non-engineering students, there will be a full daytime course on engineering fundamentals, including science and mathematics, to prepare for employment in engineering or production with concerns engaged in work related to national defense.

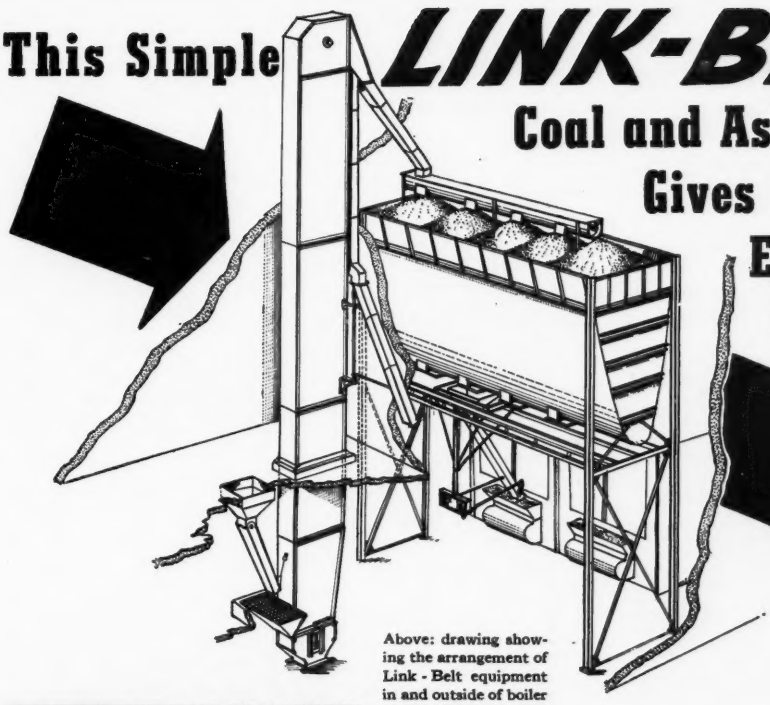
Evening courses, requiring 2 to 3 hr. on 2 or 3 days a week for 12 to 20 weeks, include machine design, production engineering and supervision, airplane structures, radio communication, concrete construction, welding engineering, testing and inspection of materials, chemistry in national defense, and foreman training. Other evening courses, outside construction cover applied mathematics, metallography, flight of projectiles, mechanisms for control of machines, and use of engineering instruments employed in design and manufacture.

Other engineering schools in New England are preparing to offer similar courses, the programs being planned by individual colleges with co-operation of regional advisor Dean Edward L. Moreland of Mass. Inst. of Technology.

Application for detailed information on all courses in the Boston area should be made promptly, *by mail only*, to Engineering Defense Training Bureau, Room 7-102, Mass. Inst. of Tech., Cambridge, Mass.

Similar courses are being offered by State Universities and by independent engineering schools throughout the country and information about details can be had by writing to the Dean at any college from which it is desired.

This Simple LINK-BELT Coal and Ashes Handling Unit Gives HOSPITAL a Most Efficient, Economical Installation



Above: drawing showing the arrangement of Link-Belt equipment in and outside of boiler room. At left is shown chute from outside hopper, feeding to bucket elevator, which handles either coal from the trucks to overhead bunkers inside the boiler room or ashes from the lower level to trucks, discharging by means of the swiveling spout shown.

Centrifugal discharge bucket elevator and receiving hopper into which coal is discharged from delivery trucks. Space under this unloading platform can also be used for auxiliary coal storage when necessary.

View inside boiler room showing the 500-lb. capacity, hand-propelled weigh larry discharging coal to stoker hopper.

● In modernizing its boiler room, a southern hospital was able to install practically all new equipment—including this simple Link-Belt coal and ashes handling system—with little alteration to the existing building. The Link-Belt unit, which consists essentially of a coal receiving hopper, bucket elevator, distributing screw conveyor to the bunker, gates and a weigh larry, has not only made an efficient and economical arrangement but has also eliminated a tremendous amount of dust that was a disturbing factor. The weigh larry enables the hospital to maintain an accurate check on the exact quantity of coal used and to maintain its boilers at maximum efficiency. Send for Link-Belt Book No. 1510 which shows many cost-reducing coal and ashes handling arrangements.

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Chicago, Philadelphia, Indianapolis, Atlanta, Dallas, San Francisco, Toronto
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. . . Coal And Ashes Handling Equipment

CONVEYORS · ELEVATORS · SKIP HOISTS · CRUSHERS · LARRIES · SCREENS

with . .
the improved . .

RICHARDSON AUTOMATIC COAL SCALE . . .

A guess of coal consumption in your power plant can represent the margin between profit and loss.

- Richardson Scales remove "guesswork."
- Know how much coal you are burning.
- Know how many pounds of steam per pound of coal you get. Richardson Coal Scales record the weight automatically and continuously on a reliable mechanical counter.
- Do away with the danger of miscounting weights.
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Put a continuous test on your boilers—reduce your power costs by stopping wastes in coal consumption—you will increase boiler efficiency and decrease your steam costs.

The improved Richardson Automatic Coal Scale has many added features:

- Streamline sheathing.
- Covered weighing mechanism as protection against tampering or accidental damage.
- Larger inlet spout.
- Stainless steel parts that come in contact with coal.

There's a size and type to fit your particular boiler room layout.

Write for Bulletin 21240

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80

Speed of Electrons

AN INDUCTION electron accelerator, a new device which gives electrons, the smallest negatively charged particles of matter known to science, almost the 186,000-mile-a-second speed of light in a glass doughnut of less than a foot in diameter, was recently described to the American Physical Society by Dr. D. W. Kerst of the General Electric Research Laboratory, Schenectady.

In the course of their whirling, the electrons gain 2,300,000 volts of potential, something hitherto requiring much larger apparatus and great insulation, hence the device is expected to make possible the easier performance of experiments in physics.

This accelerator looks like a miniature atom smasher of the cyclotron type but unlike cyclotrons, which can handle only positive ions at great speeds, it accelerates electrons. Instead of being made of solid iron as in the cyclotron, the accelerator's magnet, which surrounds the glass vacuum chamber, is composed of thousands of pieces of iron so that it can be used on alternating current. Instead of the electrons encircling the magnetic core by following a coil of wire, as they do in a power transformer, electrons in the induction accelerator are free to circulate about the magnetic core in the doughnut-shaped vacuum tube; hence they make many revolutions, the equivalent of a many-turned winding in an ordinary transformer. In 200,000 revolutions the electrons gain about 2,300,000 volts potential and travel approximately 60 miles.

At the end of this long flight the electrons are directed against a target. The present laboratory model of the accelerator, small enough for use on a table, produces radiation equivalent in intensity to that of ten millicuries of radium. Larger models, which can be constructed on the same principle, are expected to give more energy.

Weighing a Magic Carpet

HOW MUCH does a piece of metal floating unsupported in the air weigh?

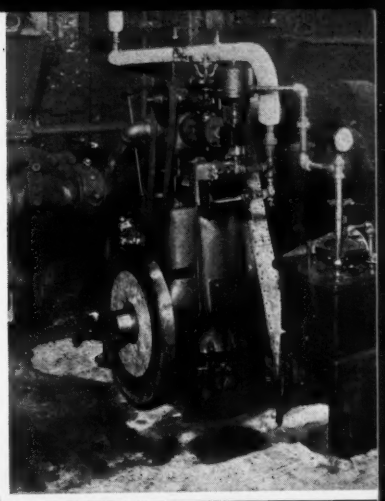
The device which gave rise to the question disconcerted many a World's Fair visitor. Called an electromagnetic levitator, and described in detail in the June 1939 G-E Review, it caused a nine-pound aluminum disk to float above it without any guides or supports. The flotation was accomplished by an ingenious application of the principle of magnetic repulsion. The levitator, containing a set of coils, resembled a small round table. The aluminum disk floated several inches above it.

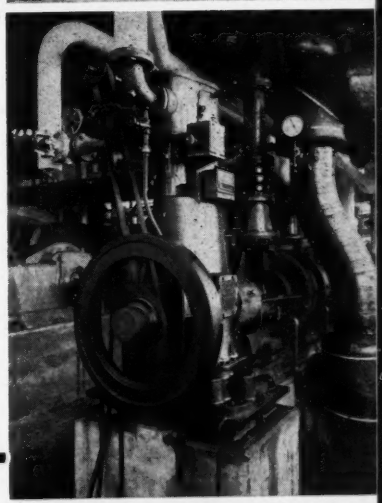
The question was this:

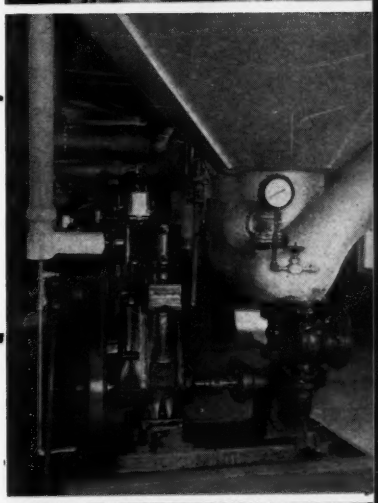
"If that machine were placed on a weighing scale during the experiment or demonstration, would the scale show the weight of the disk, too, together with that of the machine as the disk floats

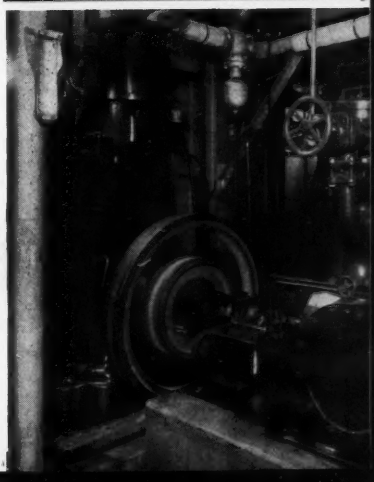
More Returns FROM A 1940-1941 SURVEY proving the Low Power Cost of the

TROY-ENGBERG STEAM ENGINE









Here are some recently compiled figures:

Driven Unit	Cost of Engine Power at Drive Shaft (all costs included)	Comparative Cost of power by other type drive	Annual Return on Installed Engine Cost	Savings pay for Engine in . . . months
Ammonia Compressor	0.30c per kw.h.	1.36c per kw.h.	144%	9
Gas Exhauster	0.69c per kw.h.	2.15c per kw.h.	152%	8
Rotary Pump	0.49c per kw.h.	0.85c per kw.h.	50%	24
Stokers	0.32c per kw.h.	1.40c per kw.h.	74%	6
Draft Fan	0.60c per kw.h.	2.20c per kw.h.	74%	17

We could cite even better savings and higher returns on the Troy-Engberg Engine investment but the above gives a good average range.

Such savings coupled with excellent drive characteristics are influencing engineers and operating men in ever-increasing numbers to purchase Troy-Engberg Steam Engines for driving their auxiliary equipment.

Why not send for details on both the economics and the mechanics of this cost-reducing power unit?

TROY ENGINE & MACHINE CO.

Established 1870

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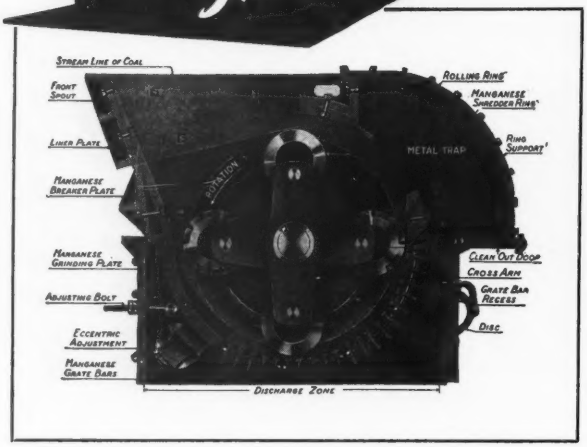
FOR
Better COAL SIZING
COMBUSTION
Install



"AMERICAN" RING CRUSHERS

● They reduce *in one operation* run-of-mine or lump coal to the proper sizes required for unit pulverizers and automatic stokers.

● Their patent Shredder Rings *split the coal* in uniform size instead of crushing it—our exclusive "American" feature.

● The better sizing assured by "American" Crushers makes possible the use of wider ranges of coals, betters combustion efficiency, results in *savings from 2½ to 8%* for many years.

● Our engineers survey each plant's coal sizing requirements before making recommendations. "American" Crushers then are installed and *guaranteed for definite performance.*

Write for Complete Engineering and Performance Data

AMERICAN PULVERIZER CO.,
1429 MACKLIND AVE., ST. LOUIS, MO.

and hovers over the machine? If not, what becomes of the disk's weight while it's 'resting' in mid-air?"

The answer is that the weight of the disk floating above the machine would still register on the scale. Here is the explanation of L. H. B. Peer of the G-E Research Laboratory:

"For every force, there must be an equal and opposite force, and if we exert a force to hold up the disk, we must push down against the levitator in order to exert this force. This push 'down' would, of course, register on the scale, and would be equal to the weight of the disk."

Human Engineering

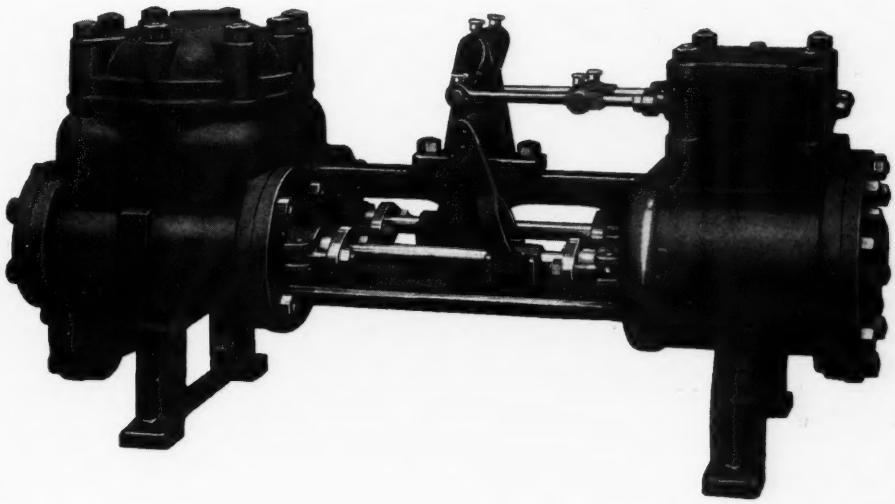
To SELL their ideas to others, engineers need to be as well versed in human equations and reactions as they are in mathematical equations and scientific phenomena. This was the message of D. C. Prince, commercial engineering manager of General Electric Co., speaking before the N. Y. Alumni Chapter of Eta Kappa Nu recently.

Mr. Prince emphasized that study of "human engineering" is a necessary part of every engineer's training, so that he can convince other people of the value of his developments and the correctness of his solutions to problems. The fact that engineers are a grand bunch of reasoners should make them adept at formulating arguments to sell their ideas to others, but unfortunately this is too seldom the case. Engineers must have faith in their convictions to win their points.

As a modern version of the Golden Rule, Mr. Prince gave, "do unto others as *they* would be done by." Think what's in other man's mind, appeal to *his* reason and sell your idea by presenting its merits. Appeal to his pride as well as his reason. Let him know you appreciate his familiarity with the subject. Incidentally, he may know a lot more about it than you think.

As a three-point program for increasing effectiveness of an engineer, the following was given; first, select a problem worth solving; second, avoiding nonessential details, approach the solution in the quickest possible way; third, when a solution is reached, convince those interested and in authority that your answer is the correct one and should be adopted. Briefly, it's matter of Selecting, Solving, Selling.

For a city of 40,000 people, housed in 51 buildings over an area of 159 acres, the central heating system is some job. In the buildings are 12,273 apartments containing 42,000 rooms, which calls for 132 miles of piping to deliver steam from four boilers. Returns are piped to an underground hot well of concrete, lined with ⅛-in. monel metal to prevent in seepage of ground water, as condensate is used for boiler feed. Joints in the metal are welded, and the whole is anchored to the concrete by 4-in. bolts. The tank is 42 by 20 ft. and 5½ ft. high. To collect any rust or scale which may get back from the piping a sump pit is sunk in the bottom of the tank 6 by 3 ft. and 10 ft. deep, also lined with monel metal.



THE PUMP

with a Plus...

WARREN "REALWEAR" HORIZONTAL DUPLEX PISTON PUMPS

Warren Realwear Horizontal Duplex Piston Pumps have made endurance records, low maintenance records, and operating efficiency records that welcome comparison. Yet the special materials and construction for extra wear and corrosion resistance are standard on this Warren line . . . an added PLUS for which you pay no premium. Check over the following points:

- **One-piece type stainless steel piston rods.**
- **Engine-type stuffing boxes, with glands held by swing bolts.**
- **Renewable bronze bushings for valve gear links.**
- **Multi-disc type pump valves of stainless steel.**
- **Valve stems protected against wear by renewable bronze sleeves.**
- **Centrifugally cast bronze cylinder liners.**

These are a few of the reasons why Warren Realwear Pumps stick with their jobs . . . keep operating and maintenance costs down . . . in long, severe service. Write for bulletin or complete Warren catalog.

WARREN STEAM PUMP COMPANY, INC., WARREN, MASSACHUSETTS

Write for free WARE HI-LAG Fuse; make your own test. See how the improved Spring Tension Contacts on both sides of the fuse links provide larger, more dependable contact surface. This avoids needless fuse blowouts caused by faulty contacts.

Improved **Spring Tension Contacts**

Plus **an exceptionally high time lag that ends blowouts caused by starting motors and momentary surges..**

Plus **the great strength of new double-bridge, self aligned, knife-blade assembly..**

Plus **full approval by the Underwriters..**

All combine to make WARE HI-LAG the outstanding buy in the fuse field. Their savings in lost time quickly repay their cost.

WARE BROTHERS
4500 W. LAKE ST., CHICAGO

Renewable
WARE HI-LAG FUSES

Iron Alloy for Hearths

FAILURE of a cast-iron hearth plate in an electric furnace, used primarily for pack hardening gears, resulted in the development of a new high silicon iron, by the Reliance Regulator Co. of Alhambra, Calif., to correct the difficulty. Replacement about once a month was necessary due primarily to the growth of the iron, subjected to continuous operation at temperatures of around 1650 deg. F.

The plates warped badly so that it became difficult to insert pack-hardening cylinders in the furnace in an upright position. Cracking was a common occurrence and in addition the formation of scale in large quantities impeded heat transfer. Several times the scale came in contact with the heating elements and the furnace burned out. It was customary to shut down the furnace each Monday to permit removal of scale and for cleaning the elements.

The composition of the new hearth plate is: total carbon 2.6 per cent; combined carbon 0.50 per cent; manganese, 1.40 per cent; silicon 5.54 per cent; chromium, 2.24 per cent; molybdenum, 1.03; nickel, 1.23; vanadium, 0.12. The castings are used in the condition in which they are shaken out of the mold without heat treatment.

In addition to stabilizing the carbides, the chromium present helps to resist scaling. The high silicon content improves the resistance to scaling, increases the resistance to growth by raising the transformation temperature above the working range and also helps prevent internal oxidation. Like chromium, molybdenum acts as a strong carbide stabilizer.

After 9 mo. service, the new alloy has shown no indication of ultimate failure. Warpage has been practically eliminated and the detrimental effects of scaling have been sufficiently reduced so as to eliminate completely the service interruptions previously incurred.

Some other practical heat-resisting applications for similar compositions are said to be tube supports for boiler or oil refinery installations, ash handling equipment where impact requirements are not severe and cooling plates for glass hot beds.

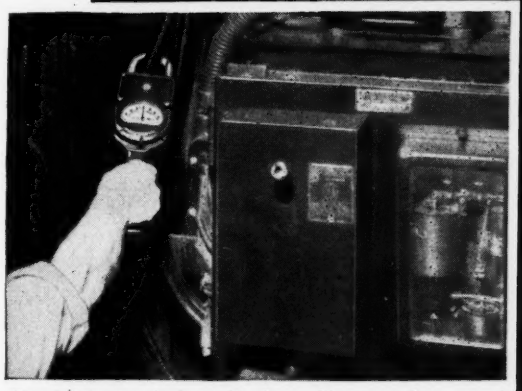
Severe Pump Service

FOR A LARGE chemical plant on the Atlantic coast, two condenser cooling water pumps of 1000 g.p.m. capacity each were furnished by De Laval Steam Turbine Co., Trenton, N. J. They operated in parallel, circulating sea water, 12 hr. a day. No. 1 had cast iron casing and bronze impeller; No. 2, nickel iron casing and monel impeller. After 9 mo. operation No. 1 pump showed graphitization of body to a depth of 3/16 in. maximum, No. 2 to 1/16 in. maximum. No. 1 impeller was considerably eroded, No. 2 in excellent condition. After 16 mo. operation No. 2 unit was in good condition but No. 1 body failed by perforation and its impeller was thinned at the edges. It was replaced by another pump of the same construction.

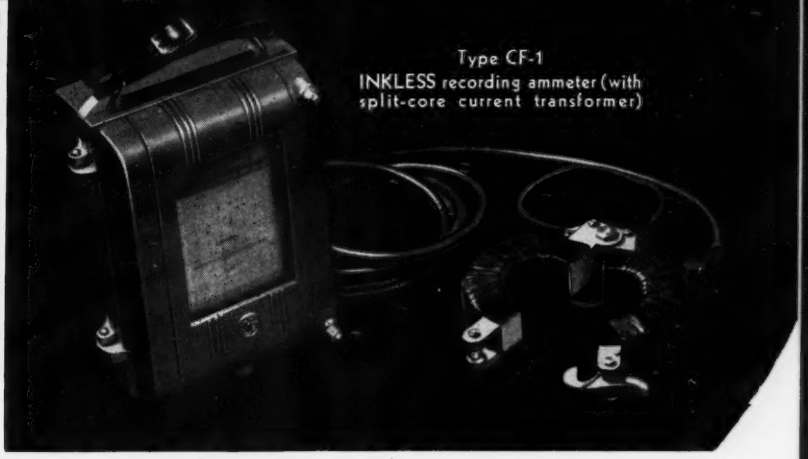
After another 5 mo. No. 2 pump was still in service but the body showed significant graphitic corrosion. The No. 1 replacement pump body was removed from service because of corrosion and the impeller installed in the new casing. No. 2 was still in service, the body graphitized to 3/16 in. deep and slight erosion at the edges of rotors. The monel construction had thus outlived two cast iron bodies.

Type AK-1
hook-on volt-ammeter

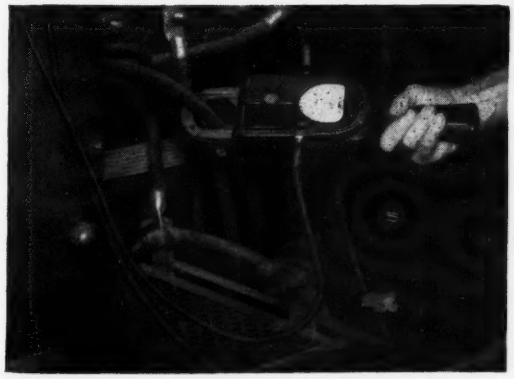
How These Hook-on Instruments Can Help Keep Production Rolling



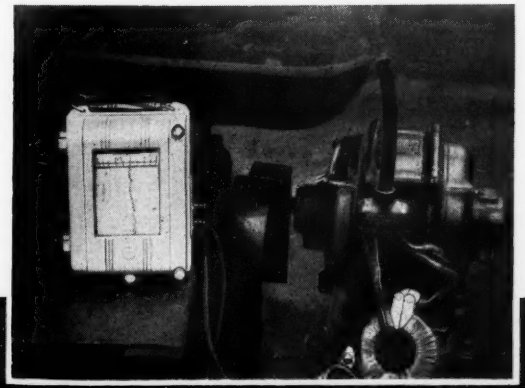
The AK-1 is made for tight places. Here it is being used for a quick, easy measurement of voltage-regulator current.



Type CF-1
INKLESS recording ammeter (with split-core current transformer)



Measuring a-c VOLTS and AMPS. Hook it around a conductor to measure amperes. Connect the voltage leads (as shown above) to measure volts. With this one setup, you can make either measurement just by flicking the selector switch.



Checking motor load with the CF-1 recording ammeter and split-core current transformer.

1. The ease of making tests encourages routine testing and promotes good maintenance, which prevents production delays.

2. Emergency tests can be made without cutting conductors—thus avoiding shutdowns.

TODAY, when motors and other electric equipment are being taxed to the limit and may be overloaded, frequent testing of circuit conditions will often avert serious production delays. These instruments will take care of almost all your testing work.

The volt-ammeter is ideal for emergency tests where a fast check of circuit conditions is needed. It measures both VOLTS and AMPERES. Having six a-c ranges, it's really six instruments in one —0-15/60/150/600 amperes and 0-150/600 volts.

The INKLESS feature of the recording ammeter makes it the handiest of recorders for general plant maintenance. With no pen to start and no inkwell to fill, it's ready to be hooked around a conductor and start recording at a moment's notice.

You're overlooking a good bet if you don't have both these handy G-E instruments for emergency and maintenance testing. For complete information on the volt-ammeter, ask for Bulletin GEA-2950; on the recorder, GEA-3187. Your G-E office has copies. General Electric, Schenectady, New York.

GENERAL ELECTRIC

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Are You Equipped to Hold Your Job?—to Get a New One?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

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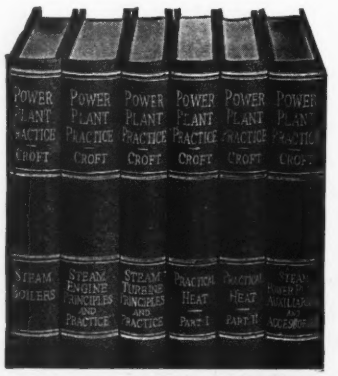

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No books dealing with the work of the power plant man were ever so complete—so authoritative—so practical in text and illustrations as these. The man who puts this set of books into his library can do so knowing that he has the utmost in power plant books—a set that will give him, in language he can understand, all the information he needs in order to get ahead in his work.

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These books are written in everyday easy-to-understand language. They are written to help the man on the job. It is just as if the author were working in the plant by your side and giving you the benefit of his vast knowledge, man to man. There's no bunkum in this Library, nor is it cluttered up with impractical theories. It is a **Power Plant Library** FOR POWER PLANT MEN.

Glance at the titles of the books in the photograph. They will give you an idea of how completely this Library covers **Power Plant Practice.** Here you have all the information necessary to make you indispensable on the job.

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Obituaries

Frederick C. Bryan

FREDERICK C. BRYAN, for 30 yr. general traffic manager of the Allis-Chalmers Mfg. Co., died at his home in Milwaukee, April 7 as the result of a heart attack.

It was Mr. Bryan's task at Allis-Chalmers to see that the turbines, electrical apparatus, farm and other industrial machinery, built by his company, safely and quickly reached purchasers all over the world, and to insure, as needed, the proper movement of all the vast supply of raw materials required to produce all this machinery.

Mr. Bryan was born in Raleigh, N. C., May 3, 1864. He attended Bingham Military School, the University of North Carolina and the Eastman School of Business in Poughkeepsie, N. Y. His long and interesting career of railroading and traffic management started at the age of 19 when he was made a clerk in the local freight department of the Atlanta and North Carolina Railroad at New Bern, N. C.

Later he was associated with railways of Virginia and the Carolinas at Raleigh, the Seaboard Air Line Railway, the Norfolk and Western Railway, became Vice-President of the St. Paul and Western Coal Co. and of the Boston Coal Dock and Wharf Co. of St. Paul, Minn. It was from this last position that he was called as general traffic manager of the Allis-Chalmers Mfg. Co.

Charles R. Richards

DR. CHARLES RUSS RICHARDS died on April 17, in Minneapolis, Minn., where he had made his home with his daughter, Lenore Richards, since retiring from the presidency of Lehigh University in 1935 due to heart ailment.

Dr. Richards, born in Clarkshill, Ind., in 1871, obtained his bachelor's and mechanical engineer's degree at Purdue University in 1890 and '91 respectively, and the master's degree from Cornell in 1895, doctor's degrees were conferred upon him by Nebraska University in 1920 and by Lafayette College in 1912. His career as an educator was started in 1891 at Colorado Agricultural College where he spent 1 yr. He then took a position as adjunct professor at the University of Nebraska at Lincoln in which institution he ascended to the position of Dean of the Engineering College. In 1911, the University of Illinois secured his services where he became Dean of the Engineering College and Director of the Engineering Experimental Station at Urbana before his acceptance of presidency of Lehigh University, Bethlehem, Pa., in 1922.

Throughout his long career as an educator he kept up a consulting engineering practice not only for the institutions receiving his major service, but also for public and private establishments. In his class rooms, his ideas were, therefore, extremely practical and applicable to the up-to-date problems of the day. He was the author of many scientific papers and reports, member of important scientific societies including fellow of the A.S.M.E. in which he was an ardent worker, and was honored by membership in scientific and engineering fraternities.

Dr. Richards is survived by his widow, Alida (Beardsley) Richards, whom he married in 1891, a daughter, Lenore, of Minneapolis and a son, Robert Watt Richards, of Aurora, Ill.

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21'6" vertical boring mill; 10', 9' and other vertical boring mills—Landis #40 horizontal floor type mill—92" planer—60" x 24' lathe. These are among 600 machine tools of various types and kinds.

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Recognition of our work by old and new customers has made possible this quick recovery from our misfortune. Tremendous improvement in and increase of our facilities permits us to fill all requirements of those purchasers and users of equipment desirous of obtaining the best product at the most reasonable prices.

Acquisition of New Facilities QUADRUPLES Capacity

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A part of the acquired Plant of Pottsville Castings and Machine Shops, Inc. Heavy Machine Work, Iron and Bronze Castings.

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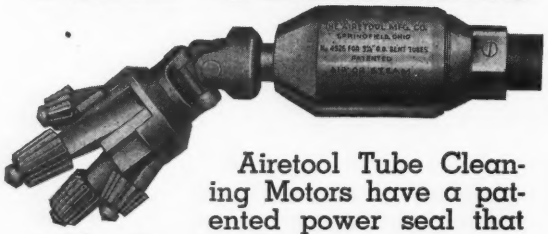
Dec. 16th Moving Machinery to Elizabeth Plant — Elizabeth Plant Overburdened but Carrying Load

UP FROM THE ASHES

Hoboken Shop Destroyed by Fire
Dec. 14th, 1940

Airetool's POWERFUL TUBE CLEANERS



Airetool Tube Cleaning Motors have a patented power seal that enables them to develop more power than any motor tested. Constant torque at low speeds prevents stalling. Starts under heavy loads. New combinations of cutter heads can now be used that were heretofore impractical. Extreme encrustation can be removed quickly without tube damage.

Motors are of slip fit construction to permit assembly without special tools. They are made of carefully selected, properly hardened alloy steel that will give longer life and have lower maintenance cost.

Cutter heads, drill heads, brushes, and vibrator heads of all types are available for tubes ½" I.D. to 20" I.D.

SMALL TUBE CLEANERS

A complete variety of these Airetool cleaners are made for tubes with extremely short radius and sharp hairpin bends. All types cutter heads, brushes and drills can be provided.

NEW TYPE BRUSH

Airetool has developed a new segment for brush cleaners. Tufts are imbedded in a solid base. They cannot be pushed out the back as in ordinary types.

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Irving H. Moran

IRVING H. MORAN died on March 20 at the South Weymouth Hospital in Weymouth, Mass. Mr. Moran was born in London County, Va., in 1886, received his engineering degree from the University of West Virginia in 1911. He was employed for a number of years by Potomac Electric Power Co., reaching the position of chief draftsman in 1923, when he was employed by Stone & Webster Eng. Corp. Mr. Moran was an engineer in the Mechanical Division of the latter company at the time of his death and had been responsible for the design of many industrial and public utility power plants, including the most recent extension to the South Meadow Station at Hartford, Conn., and the Stamford Power Station of The Connecticut Power Co.

New Engineering Books

Correcting Oil Burner Deficiencies, With Special Application To Pressure Atomizing Oil Burners. Written and published by Zuce Kogan, 724 Sheridan Road, Chicago, Ill. Size 6¾ by 9¼ in., 152 pp., cloth bound. Price $5.00.

The story behind the writing of this book is intimately tied in with the author's practice as a consulting engineer and gives, for the first time, certain relationships that have been established between the size of the burners, flame length and air pressure.

The author, in one section of the book, compares his new concept of fuel oil burning with the widespread traditional concept; another deals with the importance of adequate air pressure in the mixing of fuel and air, reducing flame length and bringing about complete combustion with a minimum of excess air. Other chapters deal with vaporization and gasification of oil, furnace temperatures, how to maintain furnace heating zones, heating refractory, fineness of atomization, burner size and range and numerous other applications of oil burner deficiencies and how they may be corrected. Also included are various self-explanatory charts and illustrations.

Handbook of Welded Steel Tubing. Published by Formed Steel Institute, 1621 Euclid Ave., Cleveland, Ohio. Size 5¼ by 8¾ in., 86 pp., imitation leather looseleaf binding. Price $1.00.

This book has been published to furnish designing engineers with full information regarding standard sizes and properties of welded tubing and exclusively devoted to those grades of welded tubing which can be figured as having a solid wall structure with no discontinuity or variation in physical properties occurring in the area affected by the welding operation during manufacture.

Included are numerous illustrations showing the wide variety of possibilities for using tubular members. Also special attention is given to recommendations for laying out fabricated parts and methods of checking, with suggestions which will aid in developing designs for the most economical use of tubular sections.

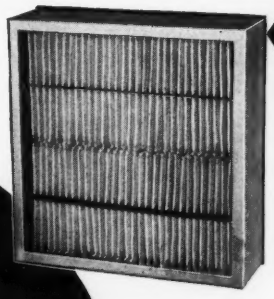
Boilers and Combustion 1940. Published by the Edison Electric Institute, 420 Lexington Ave., New York City (Mar. 1941) as Publication No. H 7. Size 9¼ by 11½ in., paper bound, 103 pp. Price $1.00 to members; $4.00 to nonmembers in U. S. A.

This is the combined report of the Boilers and Combustion Subcommittees of the Prime Movers Committee, which were merged late in 1939 to provide better co-ordination and avoid duplication. The report contains the committees, operating company and manufacturers' statements on: boilers; pulverized coal and furnaces; slagging and furnace cleaning; stokers; oil and gas firing; and combustion control.

In addition to practical operating experiences, troubles and their corrections, the report contains data on practically all the new units recently installed or under construction. Changes in boiler design over a short period of years are well shown by one table where the heat absorption in various sections of modern boilers is given in percent as: radiant surface, 55 to 60; superheater, 23 to 26; economizer, 8 to 15; and convection surface, formerly so important, 5 to 8.

Staynew AUTOMATIC FILTERS

Impingement type. Dust is caught by oil-moistened moving filter panels, automatically timed to operate at pre-determined intervals, depending on amount of dust to be removed and air velocity. A number of unusual features increase efficiency and reduce operating costs. Several features are fundamental in design and exclusive. The result is a rugged, high-efficiency unit with which extremely large volumes of air can be filtered at low cost.



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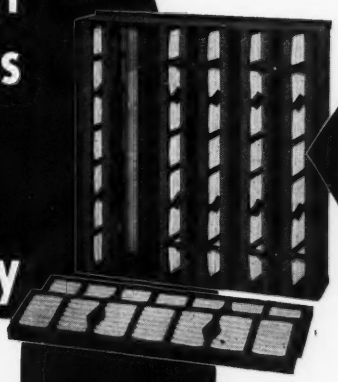
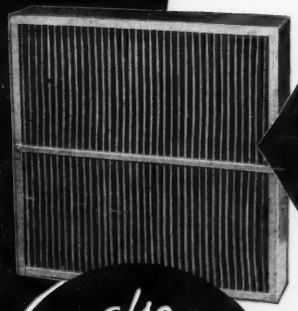
Feature famous Feltex filtering medium, extremely efficient, yet, as used in the Fin Construction, offering minimum restriction. A 20" x 20" Panel has a total filtering area of 42 square feet. Resistance at 800 c.f.m., 19 f.p.m. velocity, is only 0.2 W.G. Some of America's finest buildings are Panel Filter equipped, as is the recently built G. Fox & Co. department store of Hartford, Conn. This installation has a capacity of over 700,000 c.f.m.

Complete Line of Famous Air Filters READY for Prompt Delivery



MULTI-V-TYPE FILTERS

Lightweight, relatively inexpensive filters of great efficiency and slight resistance to air flow. Multi-V-Type Filters possess greater efficiency than the "discard" type; can be easily cleaned by vacuum or by tapping against a flat surface and will operate for long periods without appreciable increase in resistance.



WIRE-KLAD FILTERS

Low cost, long lasting. Patented construction (filter medium held between two layers of wire cloth) makes this filter extremely resistant to heat. Wire-Klad filters fulfill the provisions set forth in Section 150 of the National Board of Fire Underwriters Pamphlet No. 90.

ALL SIZES, TYPES AND MODELS IMMEDIATELY AVAILABLE

Many months ago we anticipated the present industrial expansion, adding new manufacturing equipment and buying extra stocks of materials. As a result, WE ARE READY—and you can place an order for any size, quantity or model filter with Staynew in full confidence of prompt shipment.

— also —
FILTERS FOR COMPRESSORS INTERNAL COMBUSTION ENGINES AND PUMPS

Write for Complete Catalog

Including Data Blank for Free Analysis of Your Requirements

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PROTECTOMOTOR 99⅔ Per Cent AIR FILTERS — "Air Filter Headquarters"

Power Plant Construction News

Ala., Mobile—Alabama Power Co., Birmingham, Ala., has authorized expansion in new steam-electric generating station at Chickasaw, near Mobile, supplementing work now in progress on initial plant unit. Work will include new turbine-generating unit and accessories, high-pressure boilers and auxiliary equipment, with cost estimated at $3,000,000, developing a total investment of about $7,000,000 for station. First unit will be completed late this spring, with second unit scheduled to be ready early in 1943.

Conn., Waterbury — Scovill Mfg. Co., Mill Street, manufacturer of brass, bronze and other metal products, plans installation of electric power equipment in new one-story addition, about 135 by 310 ft. Entire project will cost over $150,000. Work is scheduled to begin at once. C. A. Kendall is company engineer in charge.

Ga., Rome—Tubize-Chatillon Corporation, 2 Park Avenue, N. Y., manufacturer of rayon products, plans installation of electric power equipment in new one-story addition, 100 by 800 ft., to branch mill at Rome, for large increased capacity. Proposed to begin work in May. Cost reported close to $700,000.

Ga., Sylvania—City Council plans extensions and improvements in municipal power plant, including installation of new 450-hp. Diesel engine-generating unit and auxiliary equipment. A special election will be held early in May to approve appropriation for work.

Ill., Chicago — Pullman-Standard Car Mfg. Co., 79 East Adams Street, manufacturer of railroad cars, plans installation of electric power equipment in new plant on local site now being secured for production of aircraft parts for Government. Company will obtain fund of $1,108,900 through Defense Plant Corporation, Washington, D. C., Federal agency, for project.

Iowa, Mallard—City Council has plans under way for new municipal power station. Proposed to use Diesel engine-generating unit and accessories. Bond issue of $30,000 has been authorized. K. R. Brown, Valley Bank Building, Des Moines, Iowa, is consulting engineer.

N. J., East Paterson—Wright Aeronautical Corporation, 132 Beckwith Avenue, Paterson, manufacturer of aircraft engines, plans installation of electric power equipment in new plant unit at East Paterson, for production of engines for Government. Fund of $1,925,000 will be secured from Defense Plant Corporation, Washington, D. C., Federal agency, for project, of which about $1,650,000 will be expended for machinery and equipment.

Ky., Hazard—Kentucky & West Virginia Power Co., plans expansion in local steam-electric generating station, including installation of new 25,000-kv-a. turbine-generator unit and accessories, high-pressure boiler and auxiliary equipment, developing total capacity of about 49,000-kv-a. Cost estimated over $2,500,000.

La., Monroe—City Council plans extensions and improvements in municipal power station and electrical distribution system. A bond issue of $875,000 has been authorized for project.

N. C., Moncure—Carolina Power & Light Co., Raleigh, has plans nearing completion for new addition to steam-electric generating station on Cape Fear River, Moncure, vicinity of Sanford, to include installation of new 40,000-kw. turbine-generator unit and auxiliary equipment, doubling present capacity. Work is scheduled to begin this spring. Cost estimated about $3,000,000.

Ohio, Cincinnati — Cincinnati Milling Machine Co, Marburg and South Streets, manufacturer of machine tools, has approved plans for new steam power house at plant, reported to cost

A Modern Approach To An Old Problem

PROTECT your boilers by investigating the Garratt-Callahan Method, involving the employment of **protective colloids** to keep precipitates in suspension and prevent corrosion of boiler metal.

"MAGIC" Boiler Preservative is a carefully **processed** material, and contains protective colloids that possess selective adsorptive properties, enabling them to adsorb and hold **all** precipitates in suspension, while at the same time establishing a protective colloidal film on the metal to arrest pitting and corrosion.

Our service policy, with a 36 year back-ground in this specialized field, assures you of the most efficient and continuous operation at an economical figure.

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MAGIC BOILER PRESERVATIVE

New Oil-Burning Unit with WING Turbine Blower at Morse Twist Drill & Machine Co., New Bedford, Mass.

WING TURBINE BLOWER
Compactly Mounted on Oil Burner Windbox.

MORSE TWIST DRILLS — 15,000 different kinds produced and stocked — REQUIRE STEADY STEAMING CAPACITY for forging and heat-treating.

A new B. & W. automatically-controlled, oil-fired boiler relies on a WING Steam Turbine Blower for accurately controlled forced draft, assuring uniform boiler pressure and economical operation. Note neat, compact arrangement of blower on windbox front.

Morse Twist Drill & Machine Co. is but one of many well-known firms who are today using WING Turbine-Driven or Motor-Driven Blowers for dependable draft.

Write for Bulletin T-97A for turbine drive; Bulletin CO-4 for motor drive.

L. J. WING MFG. CO., 7th Ave. & W. 14th St., NEW YORK

Wing MOTOR DRIVEN TURBINE DRIVEN Blowers

over $100,000, with boilers and auxiliary equipment.

Ohio, Cleveland—Steel and Tubes, Inc., a division of Republic Steel Corporation, 224 East 131st Street, manufacturer of steel tubing, etc., plans installation of electric power equipment in new two-story addition, 83 by 450 ft. Entire project will cost over $200,000. Proposed to begin work soon.

Ohio, Versailles—Board of Public Affairs has plans nearing completion for extensions and improvements in municipal power plant, including installation of additional equipment. Estimates of cost are being made. Martin L. Burden, Alexandria, Ind., is consulting engineer.

Pa., Butler—American Rolling Mill Co., Middletown, Ohio, plans installation of electric power equipment, including electric furnace units and accessories, in new addition to branch mill at Butler. Cost estimated about $650,000.

Pa., Coatesville—Lukens Steel Co., plans installation of electric power equipment in new additions to mill for production of ordnance materials for Government, which will provide a fund of $2,400,000 for buildings and equipment.

S. C. Newberry—South Carolina Reserve Electric Power Co-operatives, Inc., care of Munson Morris, Aiken, S. C., president, recently organized, plans two electric power plants at Newberry and Moncks Corner, respectively, for power supply for rural electric systems. Cost estimated about $100,000.

Texas, El Campo — City Council plans early establishment of new municipal light and power plant. At recent special election, a bond issue of $350,000 was authorized for project. S. A. Russell, El Campo, is city engineer, in charge.

Texas, Kenedy—Central Power & Light Co., San Antonio, Texas, plans new one-story cold storage and refrigerating plant, including facilities for frozen food production. Cost estimated about $45,000, with equipment.

Texas, Marshall — United Carbon Co., Charleston, W. Va., plans installation of compressors and other equipment for expansion in carbon black plant in vicinity of McCampbell gas field area, near Marshall, forming new production unit to recently completed plant at that place. Entire project is estimated to cost close to $275,000.

Wash., Bellingham — Bellingham Plywood Corporation, Victor Olson, executive vice-president, recently organized, plans boiler house at new plywood mill on local waterfront, occupying site of former plant of Puget Sound Sawmill & Shingle Co. Also will install electric power equipment for mill service. Main unit will be one-story, 165 by 800 ft. Entire project will cost over $600,000. Henry Ward Beecher, Securities Building, Seattle, Wash., is consulting engineer.

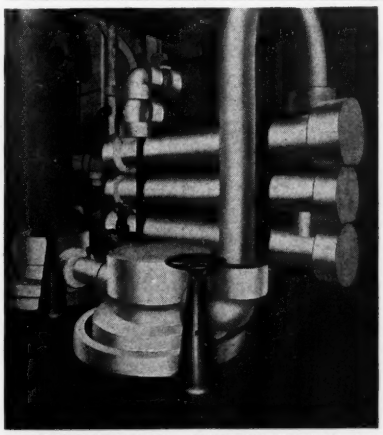
Wash., Camas — Crown-Willamette Paper Co., manufacturer of paper products, plans installation of electric power equipment in new four-story addition to mill, 110 by 120 ft., for expansion in converting department for paper bag and allied manufacture. Cost reported over $150,000. Company is a division of Crown-Zellerbach Corporation, 343 Sansome Street, San Francisco, Calif.

Wash., Tacoma—City Council is considering new municipal hydroelectric pow.r plant on Nisqually River, near La Grande, in vicinity of present generating station at that place. Project will include power dam about 265 ft. high, and station with initial capacity of 50,000-kw., with switchyard and new transmission lines for connection with present system. Cost estimated about $11,000,000. R. D. O'Neil, Commissioner of Public Utilities, is at head of project.

W. Va., Rivesville — Monongahela-West Penn Public Service Co., Fairmont, W. Va., has approved plans for addition to steam-electric generating station at Rivesville, to include installation of new 35,000-kw. turbine-generator unit and accessories, high-pressure boiler and auxiliary equipment. Cost reported close to $3,000,000, with transmission lines, power substations, etc. Completion is scheduled early in 1943.

Wis., Danbury—Clam River Dam Co, Grantsburg, Wis., Walter M. Jensen, company official in charge, plans new hydroelectric generating station on Clam River, near Danbury, to include two hydraulic turbines with generators and auxiliary equipment. Cost estimated about $90,000. Herman T. Hagestad, River Falls., Wis., is consulting engineer.

Wyo., Lusk—City Council plans expansion and improvements in municipal light and power plant, including installation of additional equipment. Proposed to arrange bond issue of $60,000 for project.



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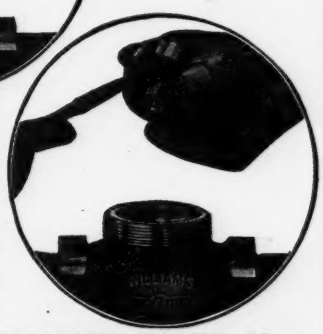

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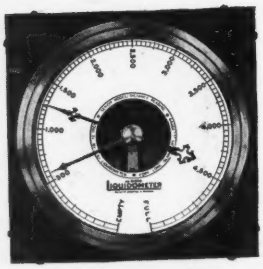

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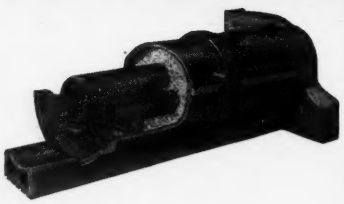

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